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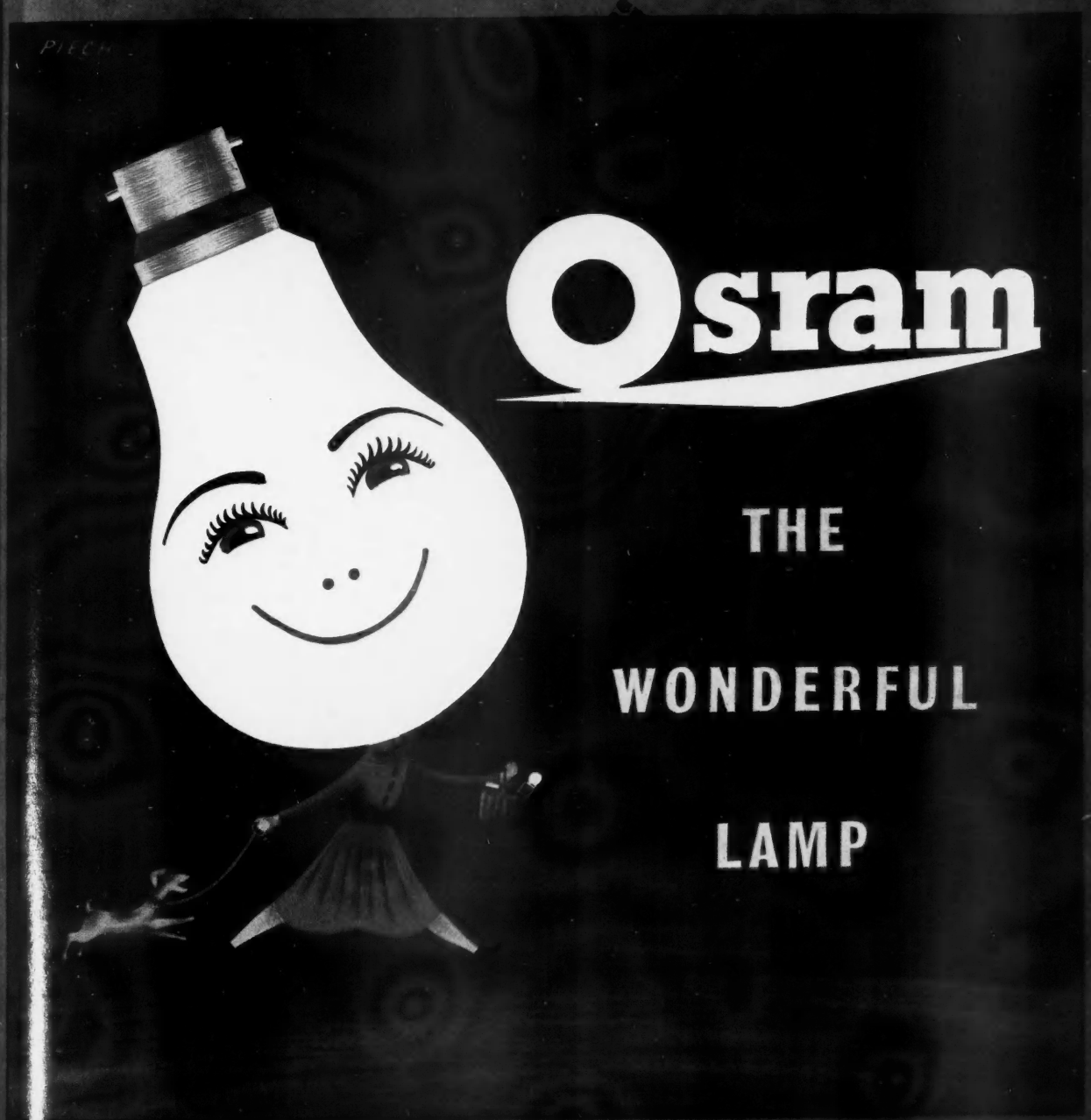
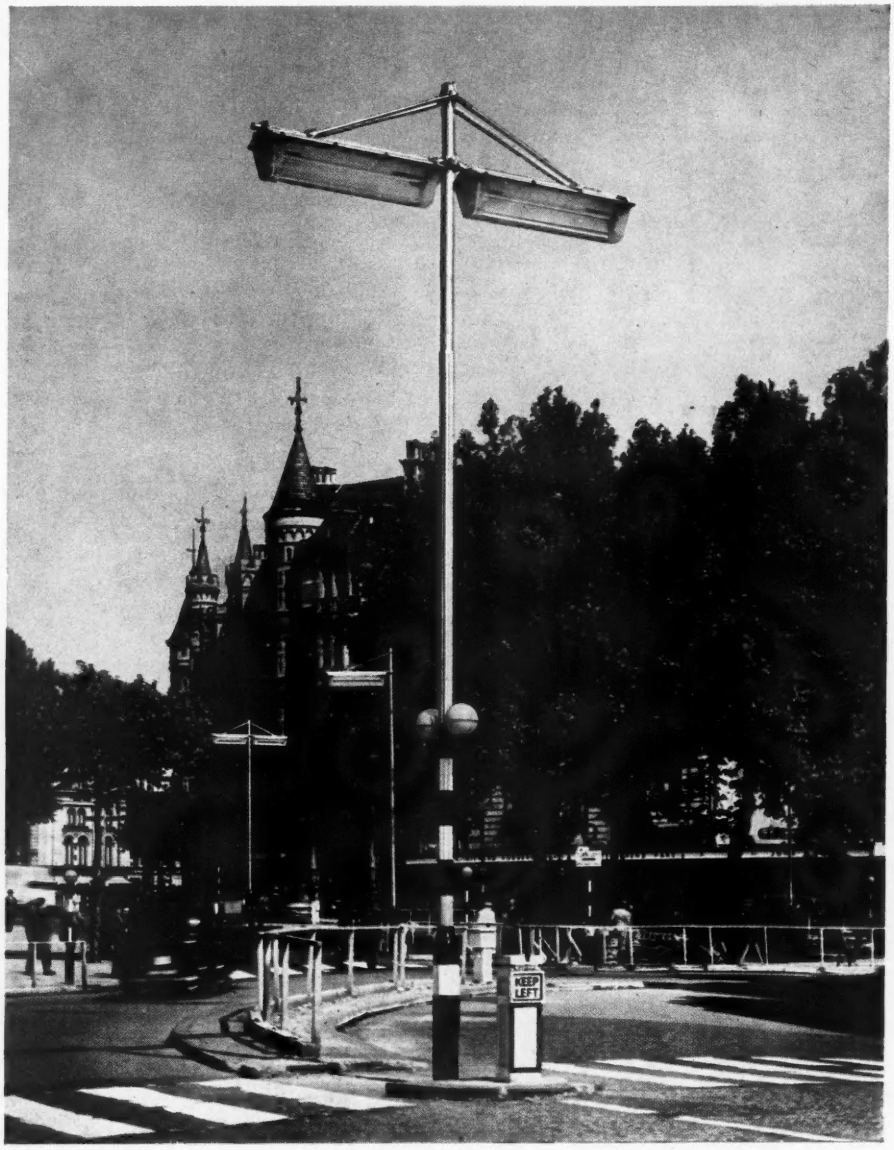
ELECTRICAL REVIEW

UNIVERSITY OF MICHIGAN

OCTOBER 1955 PRICE 1/6d.





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7 OCTOBER 1955

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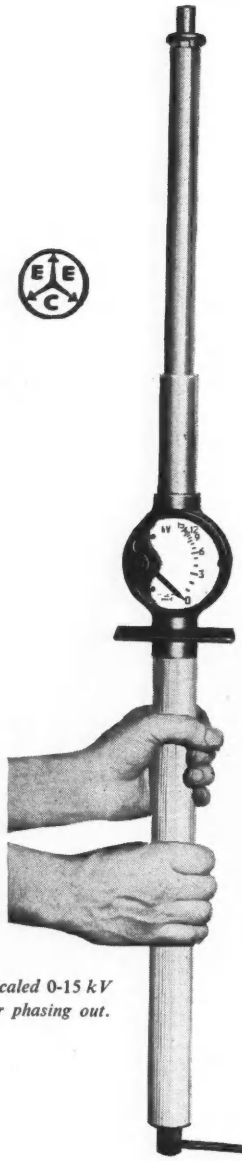

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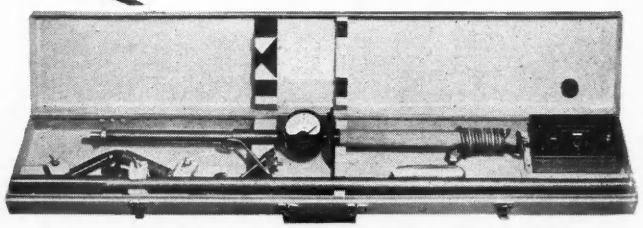

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ELECTRICAL REVIEW

7 October 1955 Vol. 157 No. 15 Established 1872

Strenuous Times Ahead

LAST week we commented on the reports of the Central Electricity Authority and the Area Boards mentioning their achievements during the year 1954—55. Now we propose to refer to these authorities' future policy as set out in the reports and supplementary remarks by Lord Citrine and the chairmen of the Boards.

Capital and coal are the two outstanding matters with which the electricity supply is at present concerned and they are likely to be abiding problems. From the very inception of the Central Authority and Boards there has been criticism, largely inspired by non-electrical interests, of the amounts expended upon capital account. The critics have deprecated provision of plant merely, as they say, to meet peak loads, while it is under-used at non-peak periods. At the same time they have crabbed endeavours to build off-peak load (principally domestic) to ensure fuller use of the plant.

We have frequently pointed out the fallacies of these arguments but now there is a restriction of capital investment which the electricity supply industry is expected to share. So far investment in generating plant has not been the subject of " economies " as it has been in the past, but the word has gone forth from the Government that more of the cost should come out of revenue. The C.E.A. concurs in this and future increases in the price of electricity will not only cover the higher coal costs but also provide a margin for " ploughing back " into the business—an accepted practice in industry.

Distribution expenditure will, however, be subjected to a cut (about 10 per cent is aimed at) and hire-purchase is being made more difficult. This may be necessary but it is uneconomical in the sense that it will militate against attempts to improve the loading of the power plant.

It seems unlikely that there will be sufficient coal for all the country's requirements in the near future. To meet the shortage the C.E.A. has been forced to go in for oil fuel for some of its power stations. At the same time the erection of atomic power plants is to proceed but this is a slow and costly business and, as Lord Citrine said last week, at the best these plants will provide only about $7\frac{1}{2}$ per cent of the total capacity needed by 1965.

Thus it will be seen that providing for the inevitable expansion of the demand for electricity in the next few years is going to tax the abilities of the electricity supply industry to the limit. The task will be eased if the Government realizes fully that national prosperity depends on electricity more than anything else and assists the industry instead of restricting it.

ELECTRICITY FACTS

The Central Electricity Authority and the Electricity Boards have all issued summaries of their reports for 1954-55 and some of them have gone further and produced " popular " versions for distribution to their employees. The C.E.A.'s own contribution is another issue of " Giant Power " which deals with outstanding points in the year's work by means of pictorial diagrams. It also contains brief descriptions of power generation, transmission and distribution with some notes on nuclear power. The Eastern Electricity Board has circulated what is, in effect, an eight-page magazine dealing with various aspects of its operation. Stress is laid upon the fact that the Board has complete control over only a sixth of its expenditure—distribution and administration. Rural consumers are told that they must make fuller use of the service to justify the cost of supplying them. A little folder setting out the salient facts about its year's work has been produced by the South Wales Electricity Board (Bwrdd Trydan Deheudir Cymru), in both English and Welsh.

BOLD POWER STATION

In this issue we describe the Bold power station which was opened last week. This is one of the very few in this country built actually on a coalfield and deriving its coal supply direct from the colliery output along a special conveyor. Although this might be expected to achieve considerable savings in cost, in practice these are not apparently so significant because of the charges involved in the provision of washing plant and the drying of wet slurry. Nor is there the saving in capital cost to the Central Electricity Authority that one might expect as practically a complete stock-piling and rail-borne coal handling plant has been installed, with the exception of extensive sidings, a fact which seems to indicate a lack of confidence in the ability of the National Coal Board to guarantee continuous supplies. The large proportion of wet slurry being used is another contribution by the Authority to the disposal of the lowest grades of coal, but a price is paid in the heavier labour costs involved in the clearing of choked hoppers and chutes and in cleaning. This is but a part of the barrel scraping process in the obtaining of fuel, indicated in the annual report published last week.

ELECTRICAL ACCIDENTS

There is a report in this issue of the address by Mr. Stanley Hardy as chairman of the Ipswich and District Electrical Association in which he referred to the importance of making sure that all parts of machinery are " well covered," adding that some machines still had parts with only a superficial covering in light brittle plastic. No direct reference appears to have been made to portable electric tools, but we feel that Mr. Hardy must have had these in mind when he made his comments, and this reminds us that some time ago we felt somewhat concerned about reports of all-insulated portable electric tools being introduced into this country, and we sought the advice of some of the portable electric tool manufacturers. In one case it was implied that although the all-insulated tool had been used on the Continent there was no possibility of its use in this country in view of the regulations here and that there was little likelihood of its manufacture being taken up in Great Britain. In any case we think that the term " all-insulated " is a misnomer which is particularly misleading in the case of portable equipment.

PUBLIC LIGHTING CONTROL

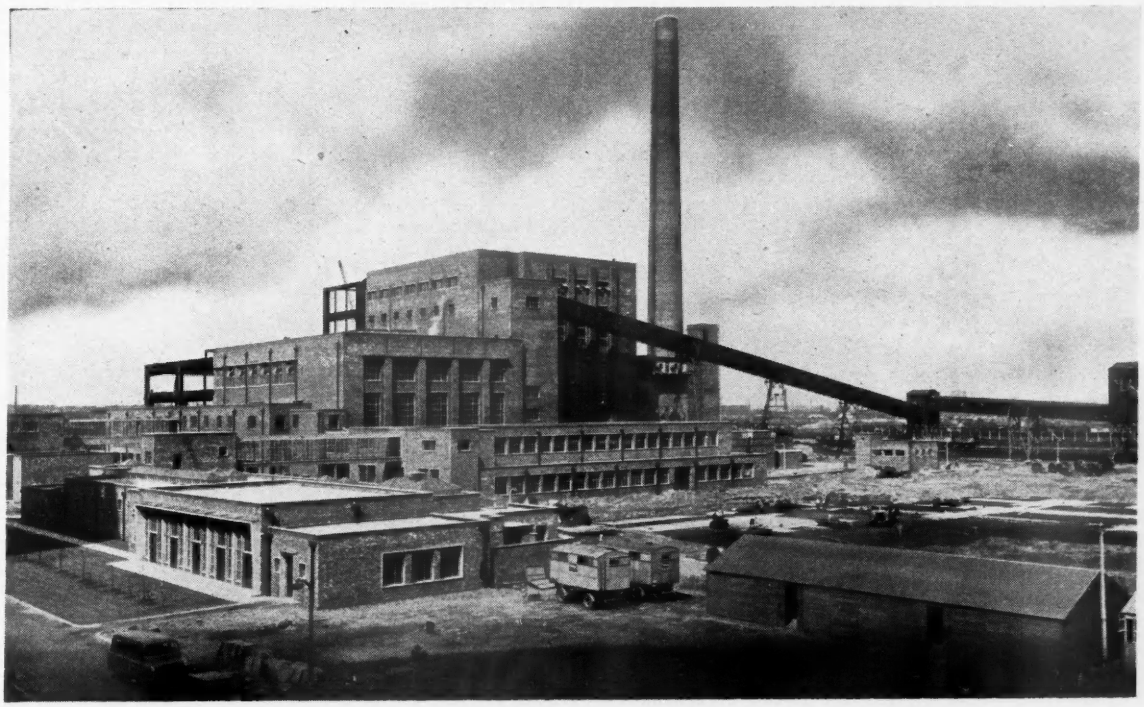
During the discussions at the recent conference at Folkestone of the Association of Public Lighting Engineers there was a good deal of argument about who should be responsible for the control equipment where injection systems of public lighting control are installed—the electricity supply authority or the public lighting authority. It seems to us to be quite unreasonable that the electricity supply authority should be expected to hand over the transmission equipment which is essentially substation gear to its consumer. On the other hand it seems to be quite reasonable that the lighting authority should have full control of its switching programme. But is that not rather a case of splitting hairs? After all in principle it is very much the same as applies in thousands of cases of high-voltage consumers. No question arises as to who should have control of the substation equipment proper—transformers, rectifiers and main switchgear—while at the same time no electricity supply authority would dream of attempting to interfere in any way with the consumers' switching times for motors and other industrial or production equipment.

PUMPED STORAGE

Transfer of load from peaks by pumping water at night from a low to a high level to be used in water turbines during the day has long been in use in some Continental hydro-electric systems. Where pumped storage is associated with steam stations, a census of the general economic position becomes more difficult. The cost of the additional kWh thus made available, less losses in pumping, is lowered by elimination of the capital charges on expensive main steam generating plant. This advantage would be offset to some extent by capital charges on the pumping equipment of head and tail reservoirs, though recent improvements in design of reversible turbine-pumps and in methods of civil engineering construction offer hopes of reducing these costs. Moreover, the reservoirs need have only a short-time storage capacity. While there appear to be few suitable economic sites in this country, the 300 MW project—of a pioneering nature—under consideration by the Central Electricity Authority shows one way of smoothing the load curve.

ELECTRICITY IN THE HOME

The 14th October issue of the " Electrical Review " will be the annual Domestic Number. It will contain illustrated revie ws of all classes of household electrical appliances showing recent introductions and developments and in addition there will be a number of special articles on domestic electrification subjects.



BOLD "A" POWER STATION

Inauguration of a Colliery-Fed Generating Plant

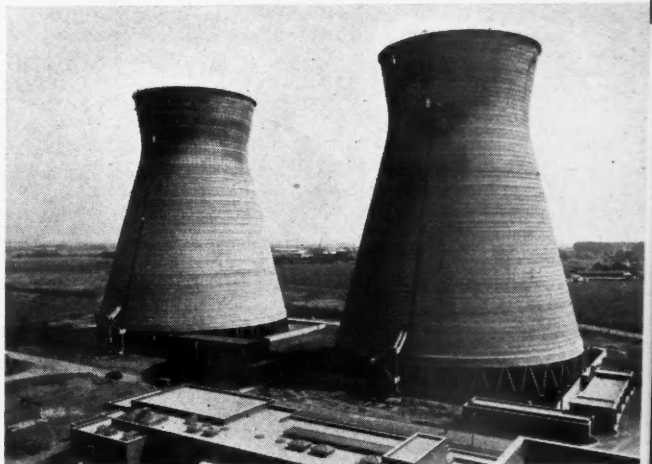
A POWER station situated in the country on the edge of the town was originally projected by the St. Helens (Lancs) Corporation which envisaged a station of 240 MW capacity made up of four 60 MW sets. Active steps had not been taken at vesting date and the Central Electricity Authority after investigating the potentialities of the site and its position in the coalfield existing in the area, decided to erect two stations: one with four 30 MW sets and the other with three 60 MW sets. The smaller station, of which the first half is completed and was officially opened last Friday, is known as Bold "A" and the projected 180 MW station on which foundation work has started, will be Bold "B."

The new station adjoins Bold Colliery and when an extensive development scheme for this colliery was prepared by the National Coal Board it was decided that coal should be normally transported from the colliery direct to the station on a series of belt conveyors. As the site adjoins the colliery and coal seams run beneath the buildings an understanding was reached with the Coal Board before construction regarding the sterilization of the mineral matter beneath the station buildings. The subsoil consists of 80ft of boulder clay deemed suitable for supporting the load of the station but 76 reinforced concrete piles were sunk to support the two brick chimneys.

Coal comes for the most part direct from the adjacent colliery. It is made up of washed fines of 1in and below and slurry extracted by a froth flotation plant and passed through centrifugal dryers. After drying the slurry is mixed with the fines and passes on a conveyor capable of taking 200 tons/hr to the weigh tower where two official batch-type weighing machines are installed. From here the coal travels on another conveyor to the main junction tower from which it may feed by a radial conveyor to stock, reclaimed from the storage area, may be supplemented by railborne coal from a side discharge wagon tippler or pass straight through to a conveyor to the next junction tower. This conveyor, No. 8, feeds the bunkers of Bold "A" via this intermediate junction tower.

Provision is made for the installation at a later date of an additional conveyor, No. 9, side by side with No. 8 but which, at the intermediate junction tower, will deliver its coal to another future conveyor at right angles, to

The two cooling towers of Bold "A" with the c.w. pump house just in front



Half a mile of conveyors bring coal to the station from Bold Colliery, seen in the distance

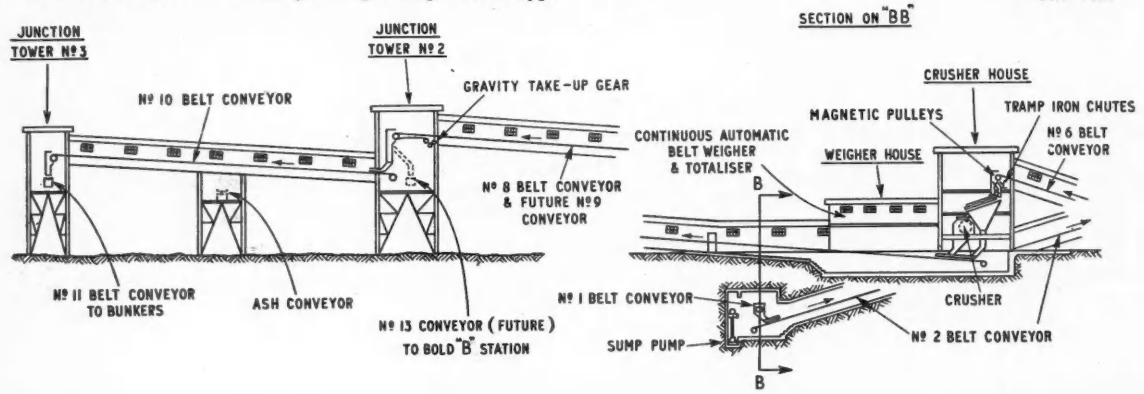
Bold " B." The conveyor arrangement is quite complicated and is shown in some detail in Fig. 1. The coal storage area has a capacity of about 115,000 tons. Inside the boiler house coal is distributed to the various bunkers by an automatic travelling tipper, and a belt weigher is fitted on the conveyor leading to the boiler house. One bunker, with a capacity of 570 tons, is provided for each boiler.

The boilers were made by Yarrow & Co., and there is one per set with a capacity of 300,000 lb/hr under steam conditions of 625 lb/sq in and 865 deg F. The guaranteed thermal efficiency of these boilers based on net calorific value is 91 per cent.

Three Lopulco type LM13 pulverizing mills per boiler each feed four burners at the corners of the boiler. Two mills are required for maximum output, the maximum rating of each mill being 19,600 lb/hr. Coal drying is carried out in the mill by hot air from air heaters, the temperature of the fuel-air mixture being controlled by dampers in the hot air ducts and in cold tempering air ducts. For lighting up, four Wallsend-Howden pressure oil fuel burners equipped with portable hand-electric ignition are situated at each corner.

The combustion chamber has a volume of 21,900 cu ft and is water cooled by bare fin tubes. The superheaters are of the Melesco self-draining multiple-loop welded type with automatic temperature control equipment actuating the tilting burners. Tubular air heaters are fitted with re-circulating air ducts and an air by-pass duct, the total area of heating surface being 79,600 sq ft. Lodge-Cottrell electro-filters are used for dust collection, the units being of the two-stage horizontal flow, high-efficiency type, using an h.t. transformer rectifier equipment designed with two single units in parallel. The efficiency of the precipitators at c.m.r. is 98·93 per cent and under these conditions 26 cwt of dust is collected per hour compared with a chimney emission of 84 lb/hr.

Fig. 1.—The coal handling system



Two forced draught and two induced draught fans per boiler, with differential inlet control, are driven respectively by single- and two-speed squirrel-cage motors of 178 and 240 h.p.

An ash and dust handling plant is able to deal with the accumulation of a cycle of two-shift operation at full boiler loading, and the operation of removing ash and dust takes a period of seven hours. A high-pressure sluicing plant removes ash from the furnace hopper after which it is carried hydraulically by a sluiceway to a sump and from there delivered by an ash pump to an 80-ton concrete bunker, discharging direct into lorries. Ash discharge from the bunker is assisted by electric vibratory feeders situated beneath it.

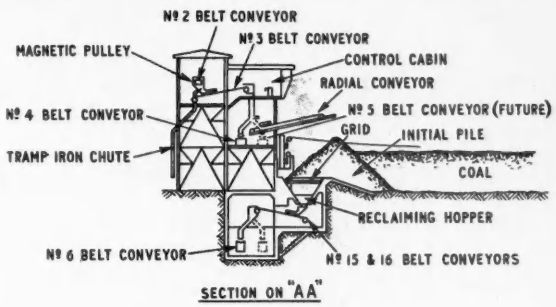
Dust handling is by an airborne suction plant taking flue dust from the bottom of the precipitator hoppers and the base of the chimney to the top of cyclone collectors which in turn discharge through vacuum unloading gear to a dust bunker of 160 tons capacity. From here discharge is into road wagons via mixer conveyors. All dust and ash is taken by lorry to Sutton Moss, a derelict area not far from the station, where it is deposited to a depth of some 12ft.

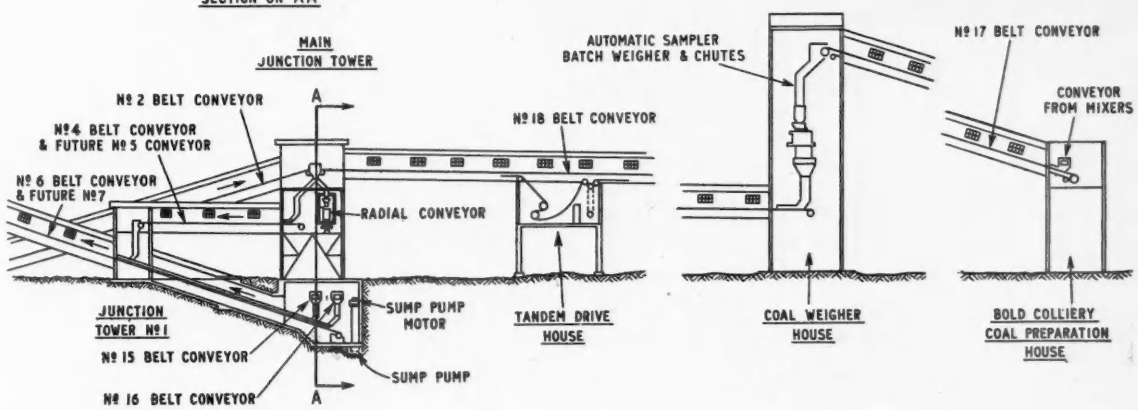
The turbines are Metropolitan-Vickers machines each of 30,000 kW output running at 3,000 r.p.m. under steam conditions of 600 lb/sq in and 850 deg F. They are of the two-cylinder impulse type: the high-pressure rotor carries 23 rows of stainless steel blades and the low-pressure rotor six (double flow) rows of stainless and nickel steel blades. The l.p. section exhausts into twin three-pass condensers containing 6,072 aluminium brass tubes. There are four bled steam heaters, two h.p. and two l.p., the final feed at full load being 345 deg F. Two full duty three-stage steam operated air ejectors and a quick start single-stage ejector are provided per set.

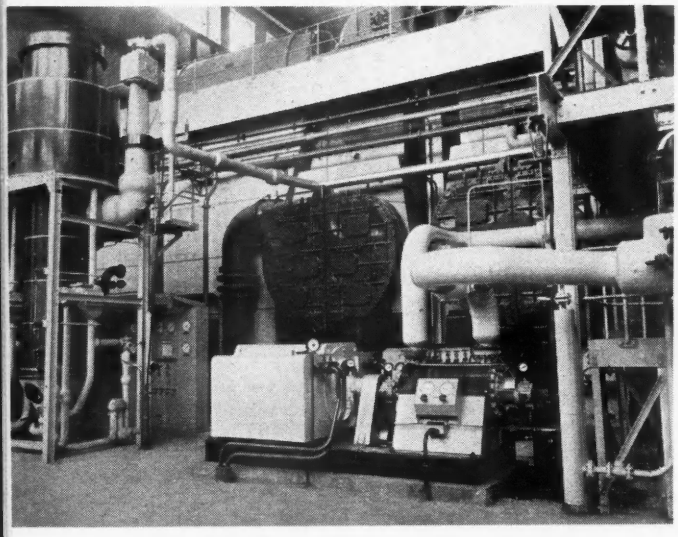
Boiler and alternator normally operate as a unit although steam cross-connections have been installed for emergency purposes. Unloading equipment is fitted on each turbine, operating automatically should the vacuum fall to a predetermined figure: if the vacuum falls below 15in of

Inside the coal washery. On the extreme left is the conveyor to the power station

Forced draught fans and ducting




MAIN JUNCTION TOWER
Nº 2 BELT CONVEYOR
Nº 4 BELT CONVEYOR & FUTURE Nº 5 CONVEYOR
Nº 6 BELT CONVEYOR & FUTURE Nº 7
A
Nº 18 BELT CONVEYOR
RADIAL CONVEYOR
JUNCTION TOWER Nº 1
SUMP PUMP MOTOR
TANDEM DRIVE HOUSE
Nº 15 BELT CONVEYOR
SUMP PUMP
Nº 16 BELT CONVEYOR
AUTOMATIC SAMPLER BATCH WEIGHER & CHUTES
COAL WEIGHER HOUSE
Nº 17 BELT CONVEYOR
CONVEYOR FROM MIXERS
BOLD COLLIERY COAL PREPARATION HOUSE



Twin condensers, with an electric feed pump in the foreground

mercury the machine stop valves are closed and the oil circuit-breaker is tripped.

Three motor driven boiler feed pumps and two steam turbine driven feed pumps have been installed in the first half of the station and a similar number will be installed when the second half is completed. The electrically driven pumps have a capacity of 330,000 lb/hr and the turbine driven pumps, half of this. The alternators are cooled by fans mounted on the rotor circulating air through coolers in the foundation block. The stator end windings are insulated with mica tape and glass tape, impregnated, and the stator core conductors are insulated with mica tape and asbestos and/or glass tape, impregnated. Micanite insulation is used on the rotor winding. Main and auxiliary exciters are fixed on the main shaft.

Feed water make-up is derived from the town water supply after passing through a primary Zeo-Karb softening plant and then through triple effect evaporators. The plant is designed to supply, automatically, blended water at the rate of 4,000 gal/hr. The central evaporators each have a capacity of 20,000 lb/hr.

The complete " A " station will have two cooling towers, both of which are already built. These feed into a pump suction chamber at the rear of the c.w. pump house from which water is delivered by two vertical spindle 23,000 gal/min centrifugal pumps. The " Film " natural draught cooling towers are 250ft high and have a diameter of 194ft at the base. Each is designed to cool 2·8 million gal of water an hour from 82·5 deg F to 70 deg F when the air temperature is 57 deg F and the humidity 70 per cent. De-icing arrangements are included and provision has been made for one half of a tower to be taken out of service for cleaning or maintenance purposes while the other half remains in operation.

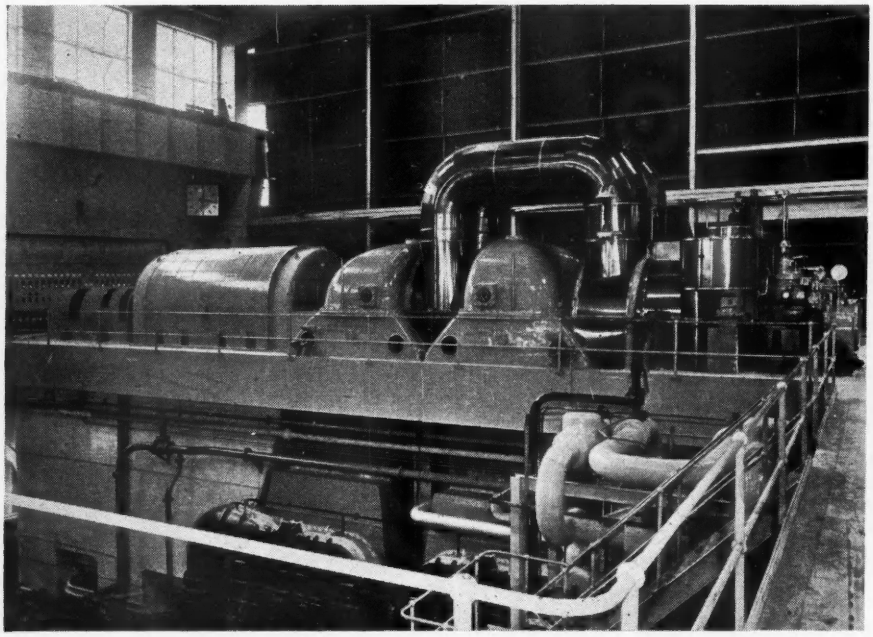
Ultimately, make-up water for cooling will be provided from the new St. Helens sewage works where treated effluent will flow into twin balancing tanks and will be pumped by vertical spindle 500 gal/min pumps, three of which are needed for the " A " station, through some $2\frac{1}{4}$ miles of twin 15in bore asbestos cement pipes to the cooling tower ponds. At present a supply of water is obtained from the St. Helens canal, this being fed into the balancing tanks and thence over the permanent installation.

Most of the power generated at Bold is absorbed locally, this being a heavy industrial area. Much of it, indeed, is used in the adjacent Bold Colliery which is extensively electrified. Power is generated at 11·8 kV and is stepped up by 36 MVA solidly connected transformers to 35·4 kV. The main station switchgear is a 33 kV board of the bulk oil type, the breaking capacity of the switches being 750 MVA. Provision is made for four generator units, two station transformer units and eleven feeder units together with a bus coupler and bus section. Some of the feeders interconnect with the older station at St. Helens to which a 132 kV substation is attached, thus providing an interconnection with the main grid. Automatic CO_2 fire protection is installed throughout the main switch house.

The 33 kV busbars are linked to the h.v. side of the generator transformers by two 0·4 sq in p.i.l.c. cables per phase and the generator itself is linked to the transformer by four 1 sq in p.i.l.c. cables.

The arrangement of the auxiliary electrical circuits follows a fairly well-established pattern, the essential connections being shown in Fig. 2. Merz-Price biased differential protection is employed on the generators and transformers together and also on the two station transformers. Monobias bus zone equipment is installed on the 33 kV switchgear.

An interesting innovation at this power station is the fitting of a Lamson pneumatic tube system linking the control room,



One of the 30,000 kW turbo-alternators

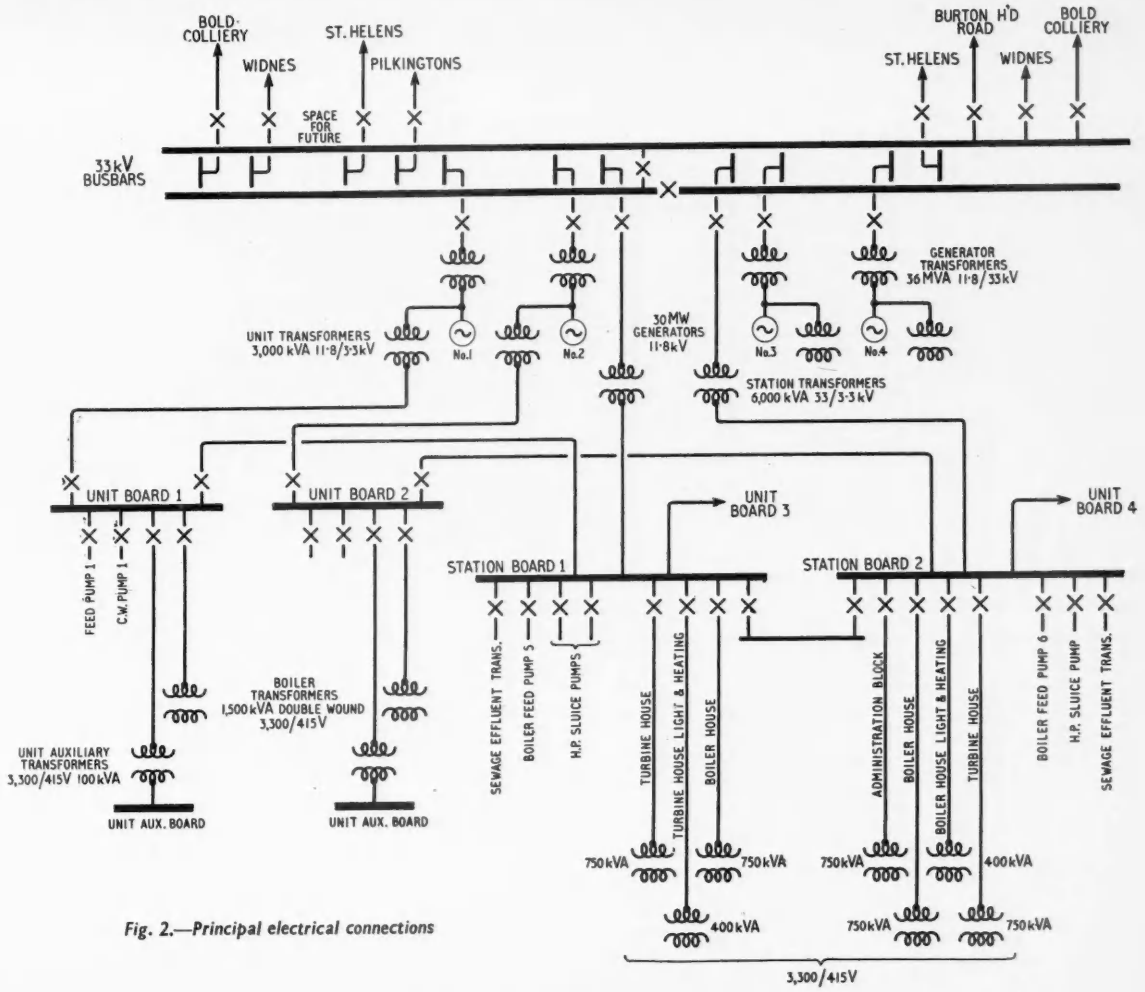


Fig. 2.—Principal electrical connections

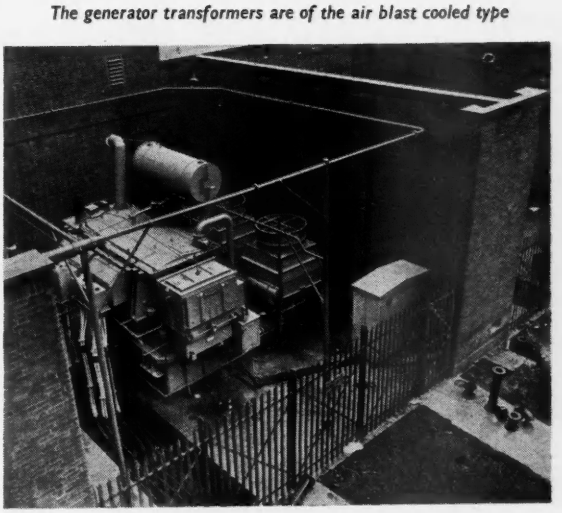
the charge engineer's office and the station office with a works office situated in the maintenance workshops. A routine has been established whereby upon discovery of any defect, mal-operation, etc., a card is filled in by the control or charge engineer and despatched immediately to the works office, who thus have fully written details immediately and can allocate an order of priority for doing the job and arrange for it to be carried out. A planning engineer is in charge of this office. It is claimed that the use of this system facilitates the organization of maintenance work and it has obvious advantages in the clearing of permits-to-work where signatures have to be seen and actual documents transferred.

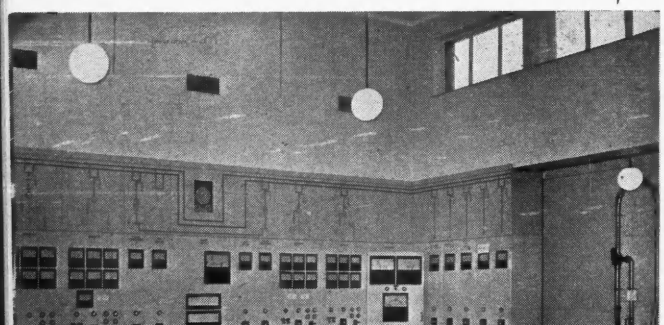
The boiler house, turbine room and other buildings are finished in rustic brickwork, the roofs of the boiler house and the turbine room being formed of aluminium roof decking covered with a 1in layer of cork and finished with two layers of bitumen roofing felt and grit. The auxiliary buildings consist of an administration block connected by a bridge to a control and electrical block which in turn is connected by another bridge to the turbine hall. A separate workshop block, and a canteen and amenity block are situated at one side of the station.

In almost every main particular the Bold "A" station is a duplicate of Roosecote which we described fully in our issue of 10th June, last.

The opening of this station was carried out on Friday, 30th September, by Mr. J. Eccles, deputy chairman (operations) of the Central Electricity Authority and retiring president of the Institution of Electrical Engineers. He said that since 1948 the Central Electricity Authority

The generator transformers are of the air blast cooled type





A Lamson pneumatic outlet to the works office can be seen to the right of the control board

had built fifty new power stations and had increased the capacity of many others. Compared with 1947 the output of electricity had increased by 76 per cent and was still growing. The housewife now used 50 per cent more electricity than in 1947, factories and shops twice as much and farmers four times as much. This year (1955) it was hoped to bring into service another 1,700 MW of generating plant, 1,000 MW more than in any year up to 1948.

The principal contractors were as follows:—Cooling towers, Film Cooling Towers (1925), Ltd. Boilers, Yarrow & Co., Ltd. Ash and dust handling plant, B.V.C. Industrial Constructions, Ltd. Coal-handling plant, Naylor Bros., Ltd. Turbo-alternators and generator transformers, Metropolitan-Vickers Electrical Co., Ltd. H.p. pipework and central evaporating plant, Aiton & Co., Ltd. Feed heating and condensing plant, Vickers-Armstrongs, Ltd. Main switchgear, A. Reyrolle & Co., Ltd. Main and multicore cables, British Insulated Callender's Cables, Ltd.

We are indebted to the Central Electricity Authority, to the controller of the North Western Division (Mr. A. R. Cooper) and to the station superintendent (Mr. R. Thistleton) for permission to visit Bold " A " and publish this account and for their assistance generally.

Science in the United States

AN interesting review of the scientific research conducted in the United States during the year 1954 is contained in a 40-page booklet, " Science in U.S.A., 1954," the third report of the British Commonwealth Scientific Office (North America) which has just been published by H.M. Stationery Office for the Department of Scientific and Industrial Research, price 2s (50 cents U.S.A.).

The money spent on research and development by the Federal Government has increased from $97 million a year in 1940 to $2,095 million in 1954. Although the major portion of the expenditure during the year was on research for defence purposes the considerable effort expended on civilian projects is shown by the range of subjects covered. These include the efficient use of solid, liquid and atomic fuels, the exploitation of solar energy by means of light cells and by way of photo-synthesis, the extraction of low-grade ores, the improvement of farm machinery and other industrial, agricultural and geological projects. An energetic programme of research into atomic energy is being carried out. Besides the work at Government establishments a great deal of research is being done with the co-operation of commercial organizations, which are being encouraged and assisted to construct and operate power reactors. Private groups are also engaged in constructing reactors for research purposes at various establishments in the United States.

The Battelle Memorial Institute, for instance, is building an atomic research centre for sponsored research into problems in the food, chemical, metal, electronic and other industries. Radiation laboratories are also being built by the Standard Oil Development Co. and the General Motors Corporation. Fundamental research by the Atomic Energy Commission ranges from the study of the effects of radiation in simple physics and chemistry to the production of biological mutations and the building up of new chemical elements.

Research by the American coal industry has led to an enlightened policy being adopted by the industry as a result of the findings. In the steel industry, for example, there is an increasing use of electric furnaces in place of open hearth furnaces for the production of low-carbon steel in consequence of the advantages of the newer method, which were confirmed by a survey. It is estimated, however, that a complete change-over to electric furnaces in the industry would require an increase of 12 per cent in the national production of electricity or, looking at it another way, an increase of 25 million tons per year in coal consumed for the production of electricity.

The industry also supports a policy of increased railway electrification, despite continued research and development on coal-fired gas turbines for locomotives, because it considers that it is extremely unlikely that coal will be re-established as the principal railroad fuel. Co-operative research is being carried out, therefore, to achieve higher fuel efficiencies at coal-fired generating stations. A considerable amount of effort is devoted in the United States to the development of synthetic liquid fuels, to the production of oil from shale and to the gasification of coal both in surface plant and in the underground seams themselves.

The view has been put forward that, as the fossil fuels become scarce and more costly, solar energy may be more important as a replacement than nuclear energy. There is, therefore, increasing interest in research in this field and many approaches are being made to the problems of finding efficient and economic methods of using solar energy. These include photo-electric devices, such as the Bell photo-electronic cell and photo-synthesis applied to the mass culture of algæ. By the use of a new technique cerium ions are successively oxidized and reduced photolytically with the liberation of oxygen and hydrogen which can be collected separately. A world symposium on applied solar energy is to be held in the United States next month.

The world is likely to become more and more dependent on lower grade ores and the development of chemical methods of extraction has already begun. The Bureau of Mines has investigated all stages of the chemical recovery of manganese from low-grade domestic sources. One method uses sulphur dioxide and 80 per cent recovery was achieved on large pilot plant scale. Another method, used on open-hearth slag, involves leaching with ammonia and ammonium carbonate after a reducing roast at 700 deg C. With an 80 per cent manganese recovery a manganese-iron ratio of 8:1 can be obtained. Metallurgical processes for the extraction of copper nickel, cobalt, uranium and other metals from low-grade ores are being studied.

Electrical Research

Recent Publications of the E.R.A.

AMONG the publications issued recently by the British Electrical and Allied Industries Research Association Report Ref. G/T296, "Effect of Arcing on the Air Flow through the Nozzle of Gas Blast Circuit-Breakers (Summarizing Report)," by A. A. Hudson, B.Sc., Wh.Sch., D.I.C. (price 21s), contains a summary of investigations into the influence of the arc upon the air flow in the nozzle electrode of an axial-flow type air blast circuit-breaker. The mass flow of air through the nozzle during arcing and the static pressure at three points within it have been measured.

The use of the mass flow ratio during arcing as a criterion in determining similar arc quenching conditions shows that this ratio may be expressed empirically as a function of the quantity $(I/d^{1.5}p^{0.5})$. There is a critical range of this quantity in which a mixture of clearances and failures occur, and which separates the region of clearances from that of failures. Regarding the centre of the critical range as the mean critical value of the ratio $(I/d^{1.5}p^{0.5})$, it is possible to correlate this quantity with switch and circuit variables other than I, d and p. So far, these include the rate of rise of restriking voltage and the distance between the nozzle and upstream electrodes (lower gap).

The possibility of extending these relationships to conditions outside the range covered in the laboratory has been checked against available experimental data. The nature of the air flow during arcing, from the arc chamber to the nozzle and thence to the atmosphere, is discussed, and the conditions leading to a reversal of flow at the nozzle entry are considered.

Spark Discharges

The effect of different electrode materials on the voltage versus gap length characteristics of 6 sec, 100 A, rectangular-current-pulse spark discharges in hydrogen, air and Argon has been investigated and the results are summarized in Report Ref. L/T287, "Electrode Processes in Spark Discharges," by R. Craig (price 12s 6d). Values of the total electrode voltage drop have been deduced; they are between 13 V and 29 V for most metal electrodes. The electrode volt drop is therefore of the same order as in the continuous arc. It was also found that the electrode voltage drop of the spark discharge is independent of gas pressure (5 to 80 cm Hg) and of current (50 to 1,000 A).

Recently, Bohm and Pines (1951, 1952, 1953) and Pines (1953) have demonstrated that the long range Coulomb interaction of the conduction electrons in metals can be treated successfully by introducing the collective modes of motion known as plasma oscillations. These are longitudinal oscillations of frequency $\omega_p/2\pi$ where

$$\omega_p^2 = 4\pi e^2 N/m$$

if N is the number of free electrons per unit volume.

Plasma Oscillations

Report Ref. L/T322, "Plasma Oscillations and Energy Loss of Charged Particles in Solids," by H. Frohlich and H. Pelzer (price 3s), points out that there exists a phenomenological connection between the possible frequencies of longitudinal electric waves and the optical constants. The theory of plasma oscillations is, therefore, a special case of the theory of absorption and dispersion. Furthermore the energy loss of fast particles can be predicted from a knowledge of the optical constants, and if the latter are known then it is possible to decide whether or not to expect energy loss in discrete steps.

Resistor Performance

The performance of Grade II fixed resistors of a particular make and type, in which the resistive element is a conductive varnish film on a glass tube embedded in a non-conductive moulding, has been investigated at the request of the Ministry of Supply. The effects of overrunning on working temperature and performance, of operating at elevated temperature without applied voltage, and of making certain changes in the manufacturing technique have been studied. Other properties and factors studied were temperature co-efficient, noise and changes of noise level during life, changes of resistance on the shelf, and "recovery" effects after prolonged loading. The results of all this work are contained in Report Ref. Z/T95, "The Performance of Insulated Carbon-Resin Film Resistors," by F. G. Rivers (price 15s).

In Report Ref. Z/T92, "Investigation of Deterioration of Moulded Carbon Resistors: First Report," by H. F. Church and J. J. Walsh (price 7s 6d), is a brief description of the results obtained during the first twelve months of a research programme to investigate the deterioration of moulded carbon resistors. The main investigation may be divided into two parts: (a) a general study of the mechanism of conduction, and (b) life test investigations. These are reported separately, but were carried out concurrently. Altogether some 350 resistors have been or are under life test. A resistor noise measuring set has been designed and built but noise measurements on the resistors dealt with in this report have not yet been made. It is hoped to include noise measurements in later work.

Solar Heat Collection

IN a paper contributed to the proceedings of the Institution of Mechanical Engineers, Dr. G. T. Ward (University of Malaya, Singapore) described the construction of a flat-plate solar heat collector which he considered could be manufactured cheaply on a large scale. The appliance, consisting of a rectangular copper plate 2ft by 1ft and $\frac{7}{64}$in thick, coated with lamp black, was enclosed in a cork-lined covered wooden box. Heat was removed by passing a stream of water through thin walled copper tubing by a $\frac{1}{2}$ h.p. motor-driven pump. Equations and charts for predicting performance with a maximum error of 15 per cent were set out.

The capital cost/sq ft of providing 50 gal storage at 140 deg F over a roof area of 48 sq ft amounted to 18·9 to 22·4 Straits dollars ($1=2s 4d sterling) depending on whether a forced or thermo-syphon system was adopted. Annual costs amounted to $102 ($92 for depreciation and $10 for maintenance) compared with $199 ($25 for depreciation and $174 for energy) when using electricity at 6 cents/kWh.

The total amount of sun's heat received between 10 a.m. and 4 p.m. averaged 350 to 400 cal/sq cm with an annual variation of ±20 per cent of the mean. Although this value was only 1½ times that at Kew, London, heat would need to be stored for five days only at Singapore compared with seven months in London to maintain an annual heat production equal to half the annual mean. Owing to high humidity at Singapore, a large proportion of radiation received was diffuse, so a mirror-focusing type of collector would have too low an efficiency to be attractive.

Magnetic Field Problems

The Application of Relaxation Methods

By HUGH McKIBBIN, M.Sc.*

UP to the present these articles have dealt with the application of relaxation methods to the plotting of electric fields. We now turn our attention to plotting magnetic fields. The actual relaxation procedure, for the type of problem considered here, differs little from that already demonstrated. It is necessary, however, to introduce a mathematical concept which will be unfamiliar to many, that of the *magnetic vector potential*, **A**. For present purposes it will not be necessary to investigate the properties of **A** fully, it will suffice to show the relation between an electric current, its associated magnetic field and the magnetic vector potential and to state the relevant equations. Anyone wishing to pursue the matter further will find Hague's "*An Introduction to Vector Analysis*" (Methuen) an excellent introductory text.

In what follows it will be assumed that the conductor arrangements considered are infinitely long in the direction of current flow which will be assumed to be parallel to the z-axis. The problems thus become essentially two-dimensional in the xy-plane.

Fig. 1 shows, for an infinitely long circular conductor, the spatial relations between the magnetic vector potential, **A**, the magnetic field intensity, **H**, and the electric current, I, which maintains the magnetic field. In general the magnetic vector potential can be resolved into three components of magnitudes A_x, A_y, and A_z directed, respectively, along the x, y and z axes. Our assumption that the conductor arrangements are infinitely long in the z-direction renders A_x and A_y zero so that A_z is the only component remaining. It is parallel to the current flow, i.e. to the z-axis, and if we follow our previous convention of considering the xy-plane to be parallel to the plane of the page, the currents and A_z will be directed perpendicularly into or out of the page.

In current-carrying regions, i.e. inside conductors, the magnetic vector potential satisfies the equation

$$\frac{\partial^2 A_z}{\partial x^2} + \frac{\partial^2 A_z}{\partial y^2} = -4\pi\mu c_z \quad \ldots \quad \ldots \quad (1)$$

where c_z is the component of the current density parallel to the z-axis and μ is the magnetic permeability of the material; in current-free regions, i.e. $c_z = 0$

$$\frac{\partial^2 A_z}{\partial x^2} + \frac{\partial^2 A_z}{\partial y^2} = 0 \quad \ldots \quad \ldots \quad (2)$$

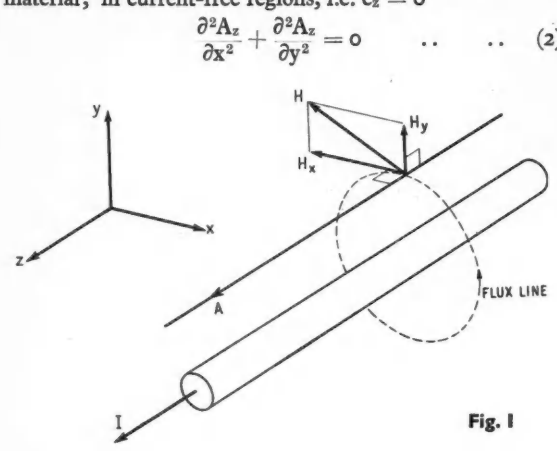


Fig. 1

It can also be shown that the components of the magnetic induction, B_x and B_y, are given by

$$B_x = \frac{\partial A_z}{\partial y}, \quad B_y = -\frac{\partial A_z}{\partial x} \quad \ldots \quad (3)$$

And if "equipotentials" of the magnetic vector potential are drawn in the xy-plane they will show the configuration of the magnetic flux lines. Our problem, therefore, is to determine such values of the magnetic vector potential in the domain, where the magnetic field plot is required, as will enable us to plot these "equipotentials" of **A**, and thus the configuration of the magnetic field.

It will be seen that equation (2) is really Laplace's equation and is therefore suitable for the relaxational treatment already given. Equation (1), Poisson's equation, differs from equation (2) only by the additional term $-4\pi\mu c_z$ and can, in relaxation, be handled similarly. Two examples will now be given to illustrate the relaxational treatment of both equations.

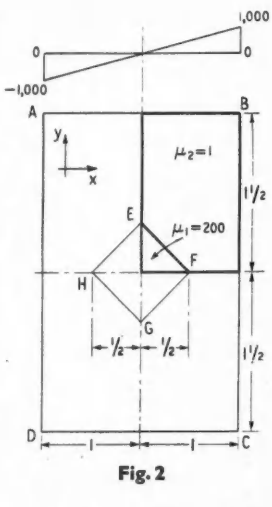


Fig. 2

The first problem is to determine the shape of the magnetic field inside the domain ABCD in Fig. 2. It is assumed that the magnitude of the magnetic vector potential is constant along the sides BC and AD and falls off linearly from B to A and from C to D. Arbitrary values of 1,000 and −1,000 have been assigned to the magnetic vector potential along these two sides and corresponding to these values the value along the vertical centre-line is zero. The square EFGH represents magnetic material of permeability $\mu_1 = 200$; the permeability, μ_2, of the remainder of the domain is unity.

Since there are no current-carrying conductors inside the boundaries the magnetic vector potential in *both* media will, assuming uniform permeabilities, be governed by equation (2). At the interface between the two media we must allow for refraction. This is done in a manner similar to that used for the electric field (*Electrical Review*, 10th June, 1955, page 1039).

It can be shown† that at an interface between two media of uniform permeabilities μ_1 and μ_2, the tangential component H_s, of the magnetic intensity is continuous, i.e.

$$H_{s1} = H_{s2} \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

The magnitude of the tangential component of the magnetic induction is given by $\frac{\partial A}{\partial n}$, where $\frac{\partial}{\partial n}$ indicates differentiation

* Carrickfergus Technical School.

† Ref.: Coulson, "Electricity" (Oliver and Boyd).

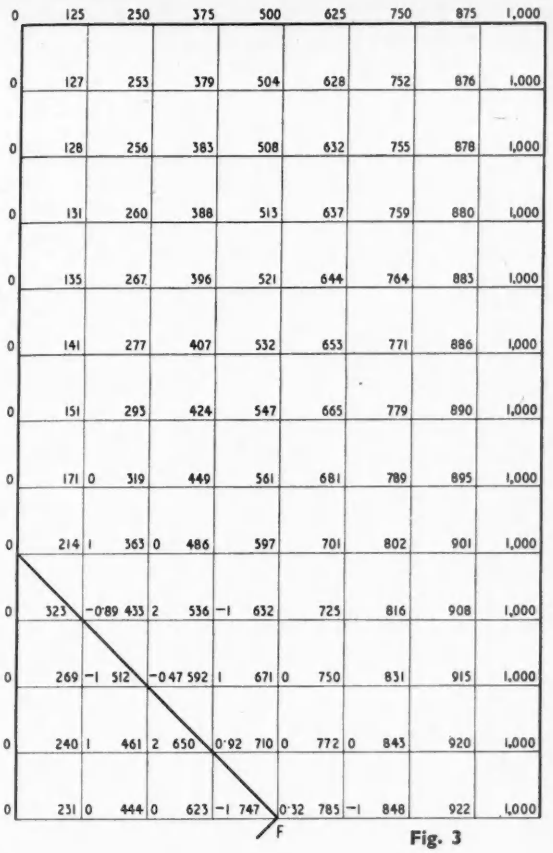


Fig. 3

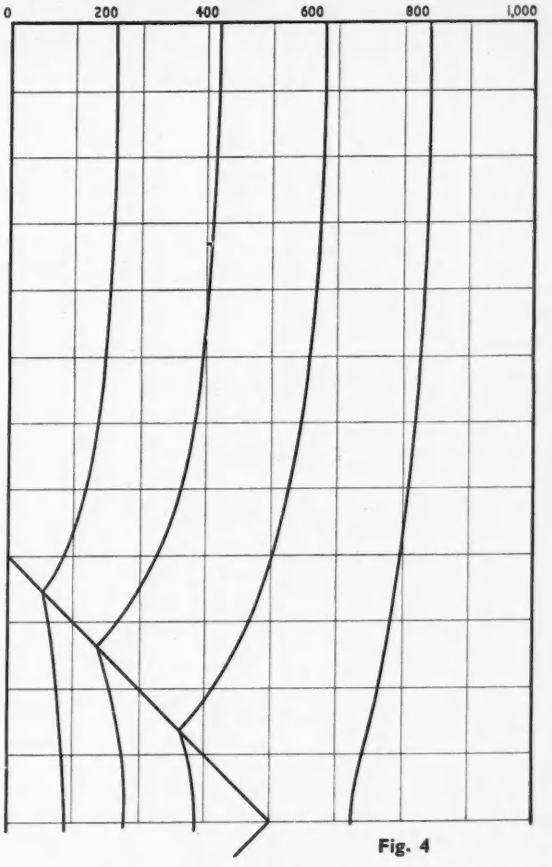


Fig. 4

along the normal to the interface, and since $B = \mu H$ we may rewrite (4) as

$$\frac{1}{\mu_1}\left(\frac{\partial A}{\partial n}\right)_1 = \frac{1}{\mu_2}\left(\frac{\partial A}{\partial n}\right)_2 \quad .. \quad .. \quad (5)$$

Comparing this relation with the continuity condition at the interface between two dielectrics, viz.

$$K_1\left(\frac{\partial V}{\partial n}\right)_1 = K_2\left(\frac{\partial V}{\partial n}\right)_2,$$

we see that (5) is similar in form. It follows that residual equations similar to those derived for electric field problems apply here. The equations required for the present problem when a net of mesh length $h = \frac{1}{8}$ is used, will therefore be given without further discussion.

Refer to Figs. 2 and 3. At the corner F the residual equation is of the form

$$F_0 \equiv \frac{2}{(1+R)}A_1 + A_2 + \frac{2R}{(1+R)}A_3 + A_4 - 4A_0 \approx 0.$$

(Compare equation (5), *Electrical Review*, 10th June.)

R here is the ratio $\frac{\mu_2}{\mu_1} = \frac{1}{200} = 0{\cdot}005$ which gives

$$F_0 \equiv 1{\cdot}9900A_1 + A_2 + 0{\cdot}0099A_3 + A_4 - 4A_0.$$

Substituting the values given in Fig. 3 we get

$$F_0 \equiv (1{\cdot}9900 \times 785) + 710 + (0{\cdot}0099 \times 623) + 710 - (4 \times 747) = 0{\cdot}32$$

for the residual at F. Note that by the symmetry about the horizontal centreline $A_2 = A_4$.

For the remaining nodes lying on the interface

$$F_0 \equiv A_1 + A_2 + R(A_3 + A_4) - 2(1 + R)A_0 \approx 0.$$

(Compare equation (12), *Electrical Review*, 10th June.) Substituting $R = 0{\cdot}005$ we get

$$F_0 \equiv A_1 + A_2 + 0{\cdot}005\,(A_3 + A_4) - 2{\cdot}010\,A_0.$$

Applying this to the first node along the interface from the corner F in Fig. 3 we have

$$F_0 \equiv 710 + 592 + 0{\cdot}005\,(461 + 623) - (2{\cdot}010 \times 650) = 0{\cdot}92.$$

At all other nodes in the domain the residual equation is

$$F_0 \equiv A_1 + A_2 + A_3 + A_4 - 4A_0 \approx 0.\ t$$

The formation of the relaxation patterns associated with the nodes adjacent to the interface should present no difficulty. (See *Electrical Review*, 10th June.) Fig. 4 shows the configuration of the magnetic field in one quadrant of the domain.

Poisson's Equation

For the example of the relaxational treatment of Poisson's equation we will determine the shape of the magnetic field inside a highly permeable conductor of rectangular cross-section. This problem has been treated by orthodox methods by Strutt.‡ A comparison between the two methods demonstrates very forcibly why relaxation methods merit more attention from electrical engineers than they have received. The orthodox treatment requires considerable mathematical facility whereas, as we have already seen, relaxation requires little more than the ability to add and subtract plus the rather obvious requirement of a firm grasp of the fundamentals of electric and magnetic field theory. Before dealing with the relaxation method the orthodox treatment will be outlined.

‡ Ref.: The original paper is in German. A summary is given by Hague in "Electromagnetic Problems in Electrical Engineering" (Oxford University Press).

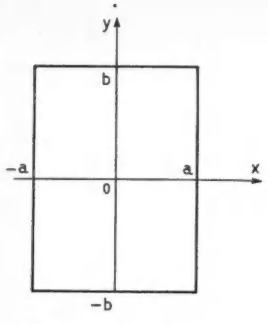


Fig. 5

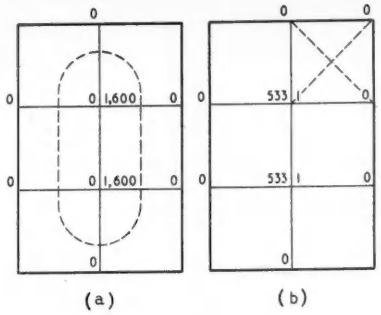


Fig. 6

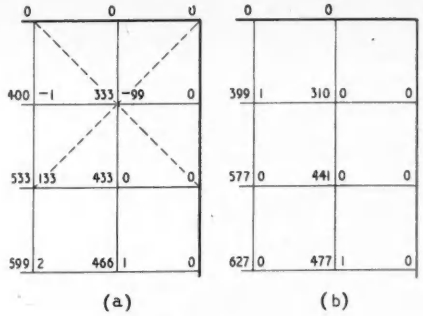


Fig. 7

When a conductor is highly permeable, i.e. when its permeability approaches infinity, and is surrounded by air the magnetic induction inside the conductor is so great compared to that in the air that it may be assumed that the magnetic flux is confined inside the boundary of the conductor, the conductor boundary becoming a flux line. This concept forms the basis of the orthodox treatment. The problem is therefore to determine a vector potential, A, which satisfies the equation

$$\frac{\partial^2 A}{\partial x^2} + \frac{\partial^2 A}{\partial y^2} = -4\pi\mu c \quad .. \quad .. \quad (6)$$

inside the conductor and has a constant value at all points along the conductor boundary. For the rectangular conductor shown in Fig. 5 Strutt found that

$$A = -2\pi\mu c\left[x^2 + \sum_{n=0}^{n=\infty} \frac{32a^2(-1)^n}{(2n+1)^3\pi^3 \cosh(2n+1)\frac{\pi b}{2a}} \cosh(2n+1)\frac{\pi y}{2a} \cdot \cos(2n+1)\frac{\pi x}{2a}\right].$$

To solve the problem by relaxation we proceed as follows. For a square-meshed net we know that

$$\left(\frac{\partial^2 A}{\partial x^2}\right)_0 + \left(\frac{\partial^2 A}{\partial y^2}\right)_0 \doteqdot \frac{1}{h^2}(A_1 + A_2 + A_3 + A_4 - 4A_0).$$

This approximation enables us to form a residual equation from equation (6); it is

$$F_0 \equiv A_1 + A_2 + A_3 + A_4 - 4A_0 + h^2 4\pi\mu_0 c_0 \approx 0 \quad (7)$$

The only difference between this residual equation and the residual equation for Laplace's equation is the term $h^2 4\pi\mu_0 c_0$. This term is only used when residuals are being calculated and does not in any way affect the liquidation procedure which is exactly the same as for Laplace's equation.

Consider a conductor of rectangular cross-section; $a = \pm 1$ and $b = \pm 1{\cdot}5$ in Fig. 5. We know that A is to have a constant value at the boundary of the conductor so we may write $A = 0$ (arbitrary) along this boundary. To commence the solution let us use a mesh of length $h = 1$ and assign a value of 1,600 to the constant $h^2 4\pi\mu_0 c_0$. (The choice of 1,600 is arbitrary because we only wish to determine the shape of the flux paths.) Taking $A = 0$ as our initial "guess" we have 1,600 as the initial residual at the two internal nodes, see equation (7) and Fig. 6 (a). Inside the dotted contour in Fig. 6 (a) the total residual is 3,200. There are 6 strings crossing the contour, therefore the block required to render the total residual inside the contour zero is $-3{,}200/-6 \approx 533$. Making this displacement at the two internal nodes we find that the resulting residual at each node is $(1{,}600 - 3 \times 533) = 1$, which is negligible. This very coarse net solution may therefore be considered complete, see Fig. 6 (b).

We now advance to a net of mesh length $h = \frac{1}{2}$. This necessitates changing the constant 1,600 to 400. The reason for this is that we must now write $\frac{1}{2}h$ for h in the term $h^2 4\pi\mu_0 c_0$ $(=1{,}600)$ which gives $\frac{1}{4}h^2 4\pi\mu_0 c_0 = \frac{1}{4} \times 1{,}600 = 400$ as the constant on the net $h = \frac{1}{2}$. The residual equation for nodes inside the conductor is now

$$F_0 \equiv A_1 + A_2 + A_3 + A_4 - 4A_0 + 400 \approx 0 \quad .. \quad (8)$$

In order to make the fullest use of our coarse net solution, Fig. 6 (b), we employ a diagonal mesh to estimate values of A at the nodes on the fine net which coincide with the intersections of the coarse net diagonals, see Fig. 6 (b) and Fig. 7 (a). When doing this it is necessary to use $h^2 4\pi\mu_0 c_0 = 800$ because the diagonal net mesh length is $\frac{1}{\sqrt{2}}$ that of the coarse net. As an example consider the top right hand corner of Fig. 6 (b). We have for the node at the intersection of the dotted diagonals

$$F_0 \equiv 0 + 0 + 533 + 0 - 4A_0 + 800 \approx 0.$$

from which $A_0 = \frac{1}{4} \times 1{,}333 \approx 333$.

When values have been calculated at all the intersections of coarse mesh diagonals it will be found that there are sufficient values to enable the remaining values on the fine net to be estimated from the residual equation (8). After values have been found for all the nodes of the fine net the residual at each node is calculated using equation (8). These values of A and the residuals are given in Fig. 7 (a). Once again advantage has been taken of the symmetry about the horizontal and vertical centre-lines to reduce the

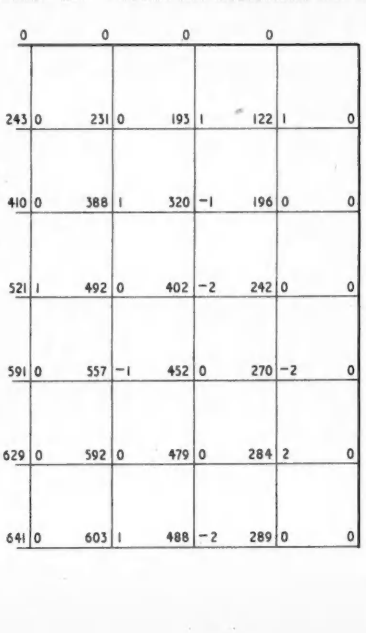


Fig. 8

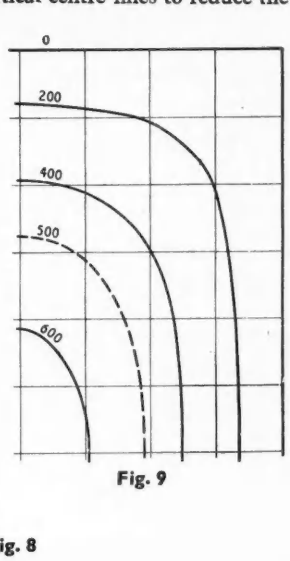


Fig. 9

work of computation. The residuals in Fig. 7 (a) are liquidated in the usual way. Fig. 7 (b) shows the values obtained with this first advance. A further advance to a net of mesh length $h = \frac{1}{4}$ gives the values shown in Fig. 8. The residual equation for the internal nodes of this final net is

$$F_0 \equiv A_1 + A_2 + A_3 + A_4 - 4A_0 + 100 \approx 0.$$

The residual equation for the auxiliary diagonal net, used in estimating the starting values on this net, is

$$F_0 \equiv A_1 + A_2 + A_3 + A_4 - 4A_0 + 200 \approx 0.$$

A comparison between the values computed on the relatively coarse net $h = \frac{1}{4}$ (Fig. 8) and those obtained using the orthodox solution reveals surprisingly small discrepancies in the relaxation values. A few values obtained by both methods are given in Table I.

TABLE I

x	0	0	0	2h	2h	2h
y	0	2h	4h	0	2h	4h
Orthodox Value	645	595	414	490	455	323
Relaxation Value	641	591	410	488	452	320

Fig. 9 shows the shape of the magnetic field over one quadrant of the conductor cross-section.

Steel Mill Modernization

New Electric Drives and Reconstruction Costing Over £1 Million

THE principal features of a rolling mill modernization scheme now in progress at the Workington Iron & Steel Co., a branch of the United Steel Companies, Ltd., are the electrification of the 32in roughing and 28in finishing stands of the rail mill and the reconstruction of the 22in fishplate mill. Costing over £1 million, the scheme entails re-siting the mill stands and extensive building alterations. It is hoped to complete the fishplate mill reconstruction by the end of this year, replacement of the existing steam engines driving the roughing and finishing stands of the rail mill by new electric drives being scheduled for completion next May. The whole scheme has been planned to cause the minimum interference to current production.

Both the roughing and finishing mill steam engine drives were installed many years ago and are now obsolescent. By installing electric motors, higher outputs will be possible because of the faster working achieved due to quicker reversing and acceleration, steady torque and the elimination of drag in the rolls when rolling the heavier ingots. Moreover, re-siting the roughing and finishing stands 40ft farther away from the cogging mill will enable the ingot weight to be increased from 3 to 3½ tons, thus yielding (in the case of a 109 lb per yard F.B. rail) three rails per ingot instead of the present two rails. Substantial economies in maintenance costs and fuel consumption are also envisaged.

Roughing and Finishing Drives

The new roughing drive will be a 2,750 h.p. reversing d.c. motor, with a speed range of 0-50 r.p.m. and 50-100 r.p.m. For the finishing drive a 2,500 h.p. reversing d.c. motor is being provided, having a speed range of 0-60 r.p.m. and 60-120 r.p.m. Both motors and all associated electrical equipment are being supplied by the English Electric Co., Ltd.

To facilitate roll changing, two 25-ton electric overhead cranes supplied by John Smith (Keighley), Ltd., are being installed on a 50ft span gantry above the roughing and finishing stands. Among other new equipment included in the modernization scheme are roughing mill pinions by B. Thornton, Ltd., ingoing racks for the roughing and finishing mills by the Brightside Foundry & Engineering Co., Ltd., and a new down-cutting billet shear with depression table by the Loewy Engineering Co., Ltd., which will cut billets up to 6in square.

The 22in fishplate mill at Workington, which is engaged principally in the production of fishplate and bearing plate bars, is very old and not equipped for fine adjustment of rolls. It is therefore being replaced by an 18in modern mill, with three three-high stands and totally-enclosed pinions. The present mill has two three-high stands and one two-high stand with open type machine-moulded pinions. The new mill will take a larger billet (up to 9ft long) which will enable output to be increased from 7,800 tons to 11,400 tons per annum.

Reconstruction of the mill is being undertaken by the Brightside Foundry & Engineering Co., Ltd. The existing 1,200 h.p. steam engine drive is being retained. A 5-ton electric overhead travelling crane, supplied by John Smith (Keighley), will be installed for roll changing on a gantry of 20ft span over the mill stands.

Reheating Furnace

Because the mill at present occupies the proposed site for the new roughing mill electric drive, it is being moved some 80ft away from its present position. At the same time, the associated reheating furnace, which is unsuitable for a 9ft billet and uneconomical in fuel consumption, is being replaced by a new Gibbons installation. This new furnace will be equipped with electrically-driven charging and pushing apparatus and will be capable of reheating 50 tons of billets in an eight-hour shift. It will be fired by coke oven gas, the hearth dimensions being 34ft long by 10ft 6in wide.

The civil engineering work involved in the entire modernization scheme is being carried out by George Wimpey & Co., Ltd., the structural steelwork, including new crane gantries and roof extensions, being undertaken by the United Steel Structural Co., Ltd.

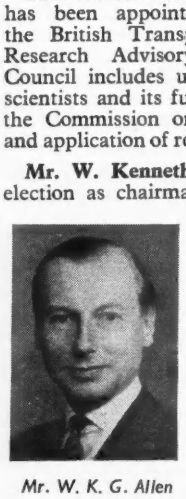
Before work could begin on the foundations for the re-sited mills, it was necessary to make arrangements for transferring some of the existing mill services elsewhere. Accordingly, the first step in the programme was to erect a new roll turning shop. This shop, which is now completed and in use is 180ft long, 57ft wide and 34ft to the eaves. It is equipped with six lathes, served by a 25-ton electric overhead travelling crane, and incorporates a number of offices, tool rooms and template stores. A new hydraulic pump house has also been built, containing three pumps, an air accumulator and three air compressors.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Professor A. Tustin, M.Sc., M.I.E.E., has been appointed a member of the British Transport Commission's Research Advisory Council. The Council includes up to eight outside scientists and its function is to advise the Commission on the organization and application of research.

Mr. W. Kenneth G. Allen, whose election as chairman of W. H. Allen Sons & Co., Ltd., Bedford, we briefly reported in our last issue, was educated at Westminster School and the University of Neuchatel, Switzerland, and commenced his career as an engineering pupil, first with Harland & Wolff, Ltd., and later at W. H. Allen's Queens Engineering Works, Bedford, subsequently obtaining experience in the main technical and commercial departments of the organization. Mr. Kenneth Allen has for some years been actively associated with many important bodies and associations, and is at present a member of the Engineering Advisory Council, the Councils of the British Electrical and Allied Manufacturers' Association, the British Engineers' Association, the British Internal Combustion Engine Manufacturers' Association (of which he has recently relinquished the chairmanship), and the Industrial Welfare Society. He is also a member of the Institute of Marine Engineers, associate member of the Institution of Naval Architects, a Liveryman of the Worshipful Company of Shipwrights, and a Freeman of the City of London.



Mr. W. K. G. Allen

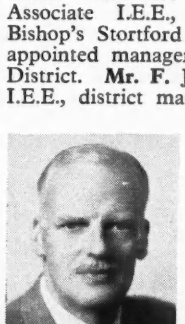
The Lord President of the Council has appointed **Professor P. M. S. Blackett,** M.A., F.R.S., Professor of Physics, Imperial College of Science and Technology, and **Mr. H. Douglass,** general secretary of the Iron and Steel Trades Confederation, to be members of the Advisory Council for Scientific and Industrial Research. **Mr. J. Crawford,** J.P., **Professor T. R. C. Fox,** M.I.Mech.E., M.I.Chem.E., and **Sir George Thomson,** D.Sc., LL.D., F.R.S., have retired from the Council on completion of their terms of office.

Mr. T. A. Nash has joined the British Central Electrical Co., Ltd., as a sales engineer. He served his apprenticeship with G. E. Taylor & Co., whom he rejoined after spending six years in the R.A.F. during the war. After leaving them in 1949, he worked for four years with Walsall Conduits, Ltd., and then for two years with Howells Electric Motors at Stoke-on-Trent.

Mr. M. Tattersfield, director and general manager of the Brush Electrical Engineering Co., Ltd., has been appointed managing director of the company as from 10th October.

Mr. W. Wallace Kerr, M.I.Mech.E., M.I.E.E., general manager of the Scottish Boiler & General Insurance Co., Ltd., has retired from that position. Mr. Wallace Kerr joined the company in 1913 and was appointed general manager in 1936. He will be succeeded as general manager by the chief engineer, **Mr. R. J. S. MacPherson,** M.I.Mech.E., M.I.Mar.E. **Mr. T. H. Dunsmoir,** M.I.Mar.E., head office engineer, will succeed Mr. MacPherson as chief engineer. On relinquishing his appointment Mr. Wallace Kerr has been elected to the board of the company.

The present Districts of Hertford and Bishop's Stortford of the Northmet Sub-Area of the Eastern Electricity Board have been merged as from 1st October, the combined District being known as Hertford with the district office at Bridgefoot, Ware, Herts. **Mr. W. H. Hatton-Ward,** Associate I.E.E., manager of the Bishop's Stortford District, has been appointed manager of the combined District. **Mr. F. J. Drake,** Associate I.E.E., district manager of Hertford, has been appointed manager of the St. Albans District in succession to **Mr. R. A. Voit,** M.I.E.E., who becomes manager, Wood Green District.



Mr. W. H. Hatton-Ward

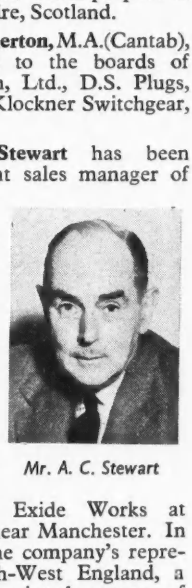
Mr. W. R. B. Wood, Associate I.E.E., district manager, Wood Green, retired on 30th September. After service in the 1914-18 war as a lieutenant in the R.A.S.C., Mr. Wood joined the Northmet Power Co. in 1920 as an assistant engineer, being appointed resident engineer, Chingford, in 1926. In 1947 he became district superintendent, Southgate, and continued in that capacity until the Southgate and Wood Green Districts were merged in April, 1951, when he became district manager of the combined District. Following his retirement, Mr. and Mrs. Wood propose to live in Wigtownshire, Scotland.

Mr. F. J. Drake

Mr. W. R. B. Wood

Mr. T. G. F. Atherton, M.A.(Cantab), has been elected to the boards of Dorman & Smith, Ltd., D.S. Plugs, Ltd., and British Klockner Switchgear, Ltd.

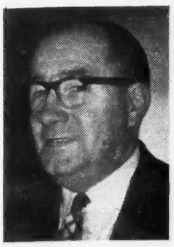
Mr. A. C. Stewart has been appointed assistant sales manager of Chloride Batteries, Ltd. He will be working in this capacity under the direction of Mr. E. Powell, director and sales manager of the company. Mr. Stewart joined the company in 1921 when, after training, he was appointed service manager at the Exide Works at Clifton Junction, near Manchester. In 1923 he became the company's representative in South-West England, a year later being appointed manager of the newly-opened Bristol Exide Depot, taking up the duties of area sales manager at the same time. He remained at Bristol until 1931, when he was recalled to head office in London to become manager of the Drydex Department of Chloride Batteries, Ltd.



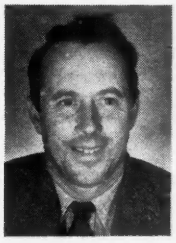
Mr. A. C. Stewart

Mr. E. H. Cook and **Mr. J. Paxton** have been appointed station superintendents of Hams Hall "C" and "B" power stations respectively of the Midlands Division of the C.E.A.

Mr. Paxton served an apprenticeship with the General Electric Co., Ltd., at Witton, Birmingham, and continued in their employment after serving in the 1914-18 war. In 1926 he joined the former Birmingham Electric Supply Department at Summer Lane power station, and transferred to Hams Hall "A" power station in 1928 as a control engineer. Mr. Paxton was also employed at Hams Hall "A" as a boiler house shift charge engineer, senior shift



Mr. J. Paxton



Mr. E. H. Cook

charge engineer, combustion engineer, and assistant resident engineer until 1947 when he was appointed station superintendent.

Mr. Cook joined the former Birmingham Electric Supply Department in 1929 as a trainee and became a boiler house shift engineer at Nechells "A" power station in 1934. In 1939 he was appointed to a similar position at Hams Hall "A" station, and in 1942 became shift charge engineer at Hams Hall "B," later holding the successive appointments of combustion engineer, deputy station superintendent and station superintendent.

Mr. K. C. Patel, D.F.H., A.M.I.E.E., is the new president of the Electrical Contractors' Association, Bombay. He is head of the firm of Patel & Partners, Nadiad.

Sir Gordon Radley, director-general of the Post Office, and **Mr. Mervin Kelly,** president of the Bell Telephone Laboratories, New York, are reported by *The Times* to have been awarded the international Christopher Columbus communications prize for their work on the transatlantic telephone project.

The Council of the Junior Institution of Engineers has awarded a Durham Bursary to **Mr. P. A. Frowley,** of Birmingham, for his thesis on "Steam Turbine Practice."

Elsewhere in this issue we refer to the opening of a Lighting Service Bureau in Manchester. The Bureau is in the charge of **Mr. Alfred Wilcock,** A.M.I.E.E., who has represented the London Bureau in the North Western area since 1951.

Mr. A. Wilcock

Mr. F. J. Pascoe has been appointed chairman of Aberdare Cables (Holdings), Ltd., and **Mr. J. P. Gilliver** and **Mr. A. J. Nicholas** become joint managing directors. Mr. Pascoe, who has been a director of the company since its inception, is chairman and managing director of British Timken, Ltd. Mr. Gilliver has been a director and secretary of the company for some years past, and Mr. Nicholas, a director of the company, is managing director of South Wales Switchgear, Ltd.

Mr. A. E. A. Wright, T.D., A.M.I.E.E., A.M.I.I.A., a member of the firm, has joined the board of Prior Stokers, Ltd. He is specially concerned with the manufacturing side of the business. He has also been elected a director of Sheet Metal Specialities, Ltd.

Mr. J. Taysom has been appointed works director of Cimex-Fraser Tuson, Ltd. Mr. Taysom received his early training with Standard Telephones & Cables, Ltd., where he served his apprenticeship; later he had a period of further training with the Austin Motor Co., Birmingham. In 1950 he was appointed assistant works manager of a North Midlands company, and in 1952 he returned to Standard Telephones & Cables as engineer of manufacture of their North Woolwich factory.

Mr. G. A. Plummer, M.I.Mech.E., M.I.Mar.E., M.A.S.M.E., has been appointed to the main board of John Thompson, Ltd. Mr. Plummer will continue as a director and chief engineer of John Thompson Water Tube Boilers, Ltd., one of the group of companies controlled by John Thompson, Ltd. In recent years Mr. Plummer has been concerned with the company's nuclear power projects, and will continue in this capacity.

Mr. G. A. Plummer

Sir William Halcrow has retired from the consulting firm of Sir William Halcrow & Partners but will continue to be associated with the firm as a consultant.

Mr. F. S. Barton, C.B.E., M.A. (Cantab), B.Sc., M.I.E.E., F.Inst.P., principal director of electronics research and development, Ministry of Supply, has been appointed adviser, defence supplies (Ministry of Supply), to the United Kingdom High Commissioner in Canada. He is succeeded as principal director of electronics research and development by **Dr. D. H. Black,** head of the United Kingdom Ministry of Supply staff, Australia, and scientific adviser to the United Kingdom High Commissioner in Australia. These positions are being taken by **Dr. W. H. Wheeler.**

As from 1st September, **Mr. D. B. Clark,** A.M.I.E.E., has been appointed assistant manager, Glasgow Office of Metropolitan-Vickers, and **Mr. A. L. Fuller,** A.C.G.I., A.M.I.E.E., becomes assistant manager, London office.

Mr. Clark joined the company as a college apprentice in 1937. During the war he served in the Royal Electrical and Mechanical Engineers, attaining the rank of Major. Returning to Trafford Park in 1946 he joined the Switchgear Sales Department, but transferred to the Glasgow office in 1952.

Mr. Fuller went to M.-V. as a vacation apprentice in 1925. After a college apprenticeship at the Trafford Park works he served for a short period on outside erection work and then with the General Engineering Department, and in 1934 he joined the London District Office staff as sales engineer. He was appointed assistant to the manager, London Office, in 1954.

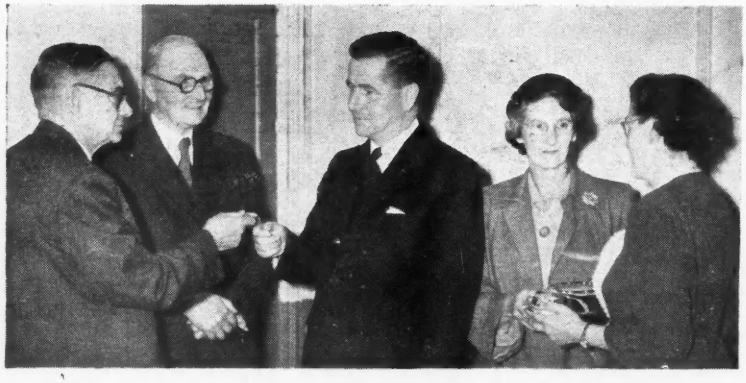
The many friends of **Mr. C. P. N. Rand,** M.A., M.I.E.E., A.M.I.Mech.E., will be pleased to learn that he has now fully recovered from his two years' illness and has rejoined his old company, Electrical & Engineering Products, Ltd., who are in association with Bonar Long & Co., Dundee.

The Ladies' Night of the **Association of Supervising Electrical Engineers** will be held on 10th December next at Park Lane Hotel, Piccadilly, London, W.1 (6.30 for 7 p.m.). Tickets are 35s each for members and their ladies and 42s each for non-members. The Dowager Lady Swaythling, O.B.E., president of the E.A.W., will be the guest of honour.

To mark the completion of half a century as a director of the Expanded Metal Co., Ltd., a presentation has been made to **Mr. J. G. Buchanan,** J.P., M.Inst.Met., M.I.Struct.E. The presentation was made on behalf of the board by Lieut.-Comdr. G. C. Hans Hamilton, chairman of the company.

A farewell dinner to **Rear Admiral Sir C. Philip Clarke,** K.B.E., C.B., D.S.O., M.I.E.E., was recently held in H.M.S. *Collingwood,* the Electrical School of the Royal Navy. Admiral Clarke is in his second year as president of the British Institution of Radio Engineers. The photograph reproduced shows Admiral Clarke's successor as Director of the Naval Electrical Department, **Rear Admiral K. H. T. Peard,** C.B.E., M.I.E.E., proposing Admiral Clarke's health.

Rear Admiral Peard bids farewell to Rear Admiral Sir Philip Clarke (second from Admiral Peard's right) at a dinner in H.M.S. "Collingwood"



(Lancashire Evening Post)

Dr. J. N. Aldington receiving the presentation from Mr. P. D. Oakley. The others in the picture are Mr. W. Higginson, Mrs. Aldington and Miss Kirkbride

A presentation was made recently to **Dr. J. N. Aldington,** managing director of Siemens Electric Lamps & Supplies, Ltd., at the company's Preston works, on his departure to take up his new appointment as managing director of Siemens Brothers & Co., Ltd. Mr. P. D. Oakley, general works manager, presented Dr. Aldington with an illuminated address and Mr. W. Higginson, on behalf of the staff, presented him with a gold watch; a silver entrée dish was presented to Mrs. Aldington by Miss Doris Kirkbride. Dr. Aldington joined Siemens Electric Lamps & Supplies thirty-five years ago.

The next production of the **G.E.C. Dramatic Society** at the Fortune Theatre, Drury Lane, on 10th, 11th and 12th October (7 p.m.), will be in aid of two charities, the Electrical Trades' Commercial Travellers' Association and the Royal Association in Aid of the Deaf and Dumb. The play to be performed, "Johnny Belinda," by Elmer Harris, has never before been presented on the West End stage.

The annual ball of the **Association of Electrical Machine Trades** will be held on 4th November at the Savoy Hotel, London.

The speaker at last week's luncheon of the **Batti-Wallahs' Society** was Sir Ernest Gowers, G.C.B., G.B.E., who is not only well known for his work with the Civil Service, but also for his advocacy of the correct use of the English language, on which he is the author of a number of books. Summarized, his entertaining address stressed the importance of making oneself understood in as concise a form as possible and he pointed out the dangers of using words in their wrong order, illustrating this last point with some unintentionally humorous letters and memoranda collected by him during his service with various Government Departments. Sir Ernest was introduced by Mr. G. O. Watson, the president, and Sir John Hacking (a past president) proposed the vote of thanks. Mr. Watson expressed the pleasure of all present at the return of Mr. T. C. F. Bigland (the "Mate"), who has now recovered from his car accident. The next luncheon of the Society will be on Wednesday, 26th October.

On the suggestion of the workers themselves, 2,600 of their relatives and friends visited the **Exide Works,** Clifton Junction, near Manchester, on 24th September, to see the various processes of manufacturing batteries. Over 150 workers volunteered to man the machines on the Saturday afternoon. No official guides were provided and the employees themselves looked after their own families and friends and explained in detail the work that was going on. Following their tour of the works the visitors were given tea in the canteen.

OBITUARY

Mr. Gordon S. Sommerville, A.M.I.E.E., former borough electrical engineer, Faversham, died on 18th September at the age of seventy-seven. It was in 1900 that the Faversham Council decided to introduce an electricity supply for the town and Mr. Sommerville became the first borough electrical engineer, a position he held until his retirement in 1946.

WILLS

Mr. E. E. Hoadley, C.B.E., M.I.E.E., for 47 years borough electrical engineer and manager at Maidstone, who died on 8th July last, left £1,100 gross (£936 net).

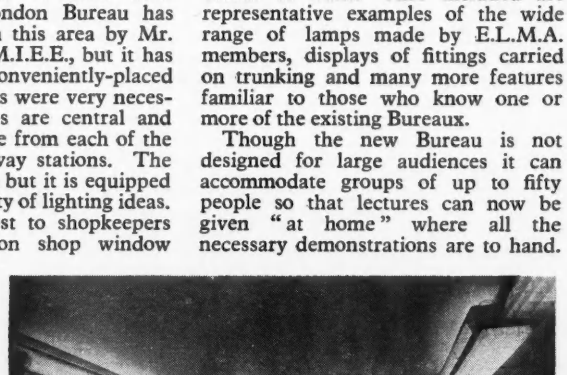
Miss Beth Card, branch development secretary of the Electrical Association for Women, who died on 7th April last, intestate, left £6,570 gross (£6,476 net).

Mr. H. Bentham, formerly chief electrical engineer to the B.E.T. Federation, Ltd., and the National Electric Construction Co., Ltd., and a director of the B.E.T. Electricity Supply Co., who died on 5th October last, left £17,324 gross (£17,237 net).

Manchester Lighting Service Bureau

THE Electric Lamp Manufacturers' Association opened a new Lighting Service Bureau at 36, St. Ann Street, Manchester, on Thursday last week to serve the North Western area. Since 1951 the London Bureau has been represented in this area by Mr. Alfred Wilcock, A.M.I.E.E., but it has long been felt that conveniently-placed demonstration rooms were very necessary. The premises are central and only a short distance from each of the four main line railway stations. The new Bureau is small but it is equipped to show a wide variety of lighting ideas. Of particular interest to shopkeepers is the demonstration shop window containing modern lighting equipment. Among a large number of other demonstrations are some which explain the principles of lighting design, the influence of light in relation to the speed of vision, brightness contrasts and matters connected with room proportions and the colour of walls. Also included are representative examples of the wide range of lamps made by E.L.M.A. members, displays of fittings carried on trunking and many more features familiar to those who know one or more of the existing Bureaux.

Though the new Bureau is not designed for large audiences it can accommodate groups of up to fifty people so that lectures can now be given "at home" where all the necessary demonstrations are to hand.



Part of the new Manchester Lighting Service Bureau. Left: A display of lamps. Centre: Demonstration shop window above an illuminated showcase. The ceiling fittings can be concealed behind trap-doors in the far wall when not in use

VIEWS on the NEWS

By REFLECTOR

THIS time, generally speaking, the national newspapers have treated the reports of the C.E.A. and Electricity Boards kindly. On previous occasions there have been many unjust criticisms. It is true that the *Manchester Guardian*, sticking to its line, questions whether domestic consumers are charged enough during peak hours but it heads its comments "Success Story." Some of the other papers do not see the necessity for any further increases in charges in view of the Boards' "profits" and the *News Chronicle* suggests that the decision to maintain a high rate of profit may be necessary in the face of future commitments but it is not going to help in the battle against inflation. It is a complicated business, but it seems to me that if the C.E.A. saves interest charges by self-financing, the consumer should ultimately benefit to that extent.

* * *

Mr. H. J. Randall, chairman of the London Electricity Board, was "grilled" by Mr. Walter Taplin on the B.B.C. Home Service last week. Mr. Randall was asked to explain why, when the electricity supply system had made "enormous" profits, the price of electricity was to be increased. Mr. Randall had no difficulty in refuting the idea that a surplus of £18·5 million was enormous in relation to a turnover of over £360 million. He made the point so often urged by the *Electrical Review* that the service was a business and had to be run on commercial lines. Mr. Taplin agreed but still asked whether the price could not be reduced. Mr. Randall showed that improved efficiency of production and distribution had done a great deal to keep the price down but he had to say that in the face of greatly increased labour and coal costs there was little possibility of avoiding higher charges. But he ended on an optimistic note regarding the future, claiming that electricity was still the cheapest and most convenient "fuel" for most purposes.

* * *

Lord Alanbrooke was the victim of a severe electric shock while using an electric hedge trimmer recently; I am glad to know that he escaped with minor injuries. Unusually in such a case, Lord Alanbrooke blamed himself for the accident in that he failed to make sure that the appliance was in a safe condition. It is a fact that many, if not the majority, of electrical accidents are caused by negligence but I hesitate to endorse the view of a correspondent to the *Evening Standard* that users of electrical equipment should be required to pass an "electrical test," similar to that which would-be car drivers have to take. In fact, it was not a very sensible suggestion, implying, as it did, that electrical appliances are dangerous when they are not.

* * *

Because the demand for its television components has not reached the anticipated level, although it is greater than a year ago, the Edison Swan Electric Co. is reported by the *Manchester Guardian* to have warned the employees at its Enfield factory that there might be some "redundancy" later on. Thereupon the shop stewards at the works decided to carry on a sales campaign of their own. Their intention is to send representatives to "every foreign embassy in London to canvass orders for the firm's products." What effect this novel undertaking will have is uncertain and I, in company with Ediswan, will be "very interested in the results."

* * *

Advocates of solid fuel are going around quoting 2s 6d as the cost of a therm of electricity which, of course, is approximately (or arithmetically) true, a therm, 100,000 B.Th.U., being equivalent to about 29 kWh and the cost of 29 kWh at around 1d/kWh being 2s 6d. Efficiency of use is, of course, entirely overlooked and this becomes ludicrous when solid fuel is brought into the picture. At a "Warmer Homes" Exhibition at Dover, Mr. E. Bellingham, director-general of the Coal Utilization Council, quoted the figure of 2s 6d per "useful" therm for electricity and went on to say (as reported by the *Dover Express*)

> "With the use of a properly selected and properly installed appliance using solid fuel the cost was not more than 1s per useful therm."

What a world of significance lies in the phrase "properly selected and properly installed" and how much is left unsaid about the availability of appropriate fuel and several other relevant factors.

* * *

Mr. George Blake in a recent article in the *Scottish Field* objected to the modern "swan-necked" lamp standards, but a later correspondent thinks that they are "beautiful and satisfy all the æsthetic canons." He goes on to say:—

> "Besides, what is wrong with being swan-necked? Surely what was good enough for Annie Laurie should be good enough for Mr. Blake."

* * *

At a time when large sections of our railways are electrified and plans are proceeding for the conversion of further routes it is of interest to read of the reactions of railwaymen to electrification fifty years ago. At the annual meeting of the Amalgamated Society of Railway Servants, reported in the *Electrical Review* of 6th October, 1905, the president said that

> "There could be no doubt, judging from the present tendency, that the motive power of the future would be electricity. Notwithstanding the efforts of the organization and the many and various representations to the Board of Trade by their general secretary, approval had been given by that body to the running of passenger trains with one man in the cab.... Experience as cleaners and firemen, which was considered imperative before, was not now considered necessary, the policy in some cases being to draw men from almost any grade with a view to training them for motormen. There was abundant evidence of the seriousness of the situation."

INDUSTRIAL NEWS

Next Year's B.I.F.

Arrangements are going forward for next year's British Industries Fair which is to be held over two periods. The first section will be staged at Earls Court, London, from 22nd February to 2nd March and the other at Olympia, London, and Castle Bromwich, Birmingham, from 23rd April to 4th May.

As part of the service to exhibitors British Industries Fair, Ltd., Ingersoll House, 9, Kingsway, London, W.C.2, is to produce a 24-page "B.I.F. Bulletin." This will appear in November, January, March, April, June, September and October and will be sent free of charge to 12,000 actual and potential exhibitors. The managing director, Mr. Kenneth Horne, states that the contents will include up-to-date details of B.I.F. plans, progress and personnel and news and pictures of exhibitors and buyers.

Relay Exhibition

At the Birmingham Exchange and Engineering Centre last week the English Electric Co., Ltd., held an exhibition of its products in the field of protective relays, meters and instruments. It is only comparatively recently that the company has entered into the manufacture of this class of gear and with the recent increase in manufacturing capacity at the Stafford factory and a consequent shortening of delivery periods, a series of these exhibitions is being arranged. One was held in Manchester recently and in the new year the present one will be repeated in London and Glasgow.

In the field of protective gear there are a number of features of interest. The normal mounting is in a flush fitting case from which the whole mechanism may be withdrawn, after removal of the glass cover, from the front. The elements are mounted on a rigid frame which is grasped when handling on withdrawal and after. Contacts are completed via long sprung fingers at the base of the withdrawable unit and strips inside the case, current terminals being shorted automatically when the relay is withdrawn. It is possible to insert a special multi-plug between the draw-out fingers of the relay case and cradle, isolating the relays and connecting it up to a secondary injection test set.

Another innovation is the use of a printed nomogram instead of the usual curve, to show the relationship between plug setting multiplier and operating time, on induction type inverse-time relays.

On panel instruments an effort has been made to remove all superfluous marking and concentrate on clear, quick reading with thick pointers. An indicating semaphore shown has the rotary cup driven directly by the armature movement of a small telephone type relay, sticking being much less likely with such a mode of operation than with those working on an induction principle.

Exhibition of protective relays at the Birmingham Engineering Centre

B.T.H. Larne Works

The foundation stone of the offices for the new turbine factory of the British Thomson-Houston Co., Ltd., at Larne, Co. Antrim (reference to which was made in our issue of 23rd September), was laid on 29th September by Viscount Brookeborough, Prime Minister of Northern Ireland. Viscount Chandos (chairman of the company), who has recently been appointed chairman of the Northern Ireland Development Council, referred to the fact that in Ulster there were nearly 28,000 unemployed from whom a labour force could be recruited. The Government of Northern Ireland was prepared to help by making grants and by leasing plants on favourable terms to those who had established industries of a permanent nature in Ulster. The B.T.H. Co. was shutting down at Rugby all production of turbo-alternators above 30 MW which would then be produced at the Larne factory. Viscount Brookeborough said that the ceremony marked the beginning of one of the largest single post-war industrial developments to be undertaken in Northern Ireland. The number of workers employed was expected to reach some 3,200 by 1964-65.

Regulations for Ships' Equipment

The Council of the Institution of Electrical Engineers has authorized the preparation of a fourth edition of the Regulations for the Electrical Equipment of Ships, to supersede the existing third edition (1939) as amended by the 1947 supplement. The work of preparation will shortly be undertaken by the Committee on Regulations for the Electrical Equipment of Ships, who will welcome the submission of comments or suggestions from interested bodies or persons. These should be addressed to the Secretary, Institution of Electrical Engineers, Savoy Place, London, W.C.2, and should be received on or before 1st January next.

Opportunities in the Middle East

The prospects for increasing our trade with the Middle East "oil" countries, Iraq, Persia and the Persian Gulf States were discussed at two conferences held in London on Wednesday last week. In the morning representatives of public and engineering works contractors attended a conference called by Mr. A. R. W. Low, Minister of State, Board of Trade, and in the afternoon there was a Press conference. The opportunity was taken to obtain first-hand information from Sir Michael Wright, Ambassador to Iraq, Sir Roger Stevens, Ambassador to Persia, and Sir Bernard Burrows, political representative in the Persian Gulf. At the Press conference, Mr. Low said that these countries now had large sums of money to spend and they were spending their money on development schemes. This required careful planning and judicious ordering of materials and placing of contracts, which provided excellent opportunities for British firms, consultants, manufacturers and contractors. As these development schemes achieved their objectives, they would create an ever widening market for consumer goods. While British firms still had the largest share of exports to the Middle East,

great progress had been made since 1951 by Germany and Japan.

Replying to questions raised at the conference, Sir Michael Wright said that British traders would have to face intense competition, but one of the greatest problems was to obtain permanent agents with sufficient technical skill. There were many Iraqis who were willing to pay all expenses to come to Britain for technical training. Points made by Sir Roger Stevens were the need for more after-sales service of equipment in Persia, and readiness to send representatives to study local conditions. Sir Bernard Burrows said that in the Persian Gulf States there was still much more to do in the development of these States and there were many opportunities for new concerns. For consumer goods there were openings for both large and small companies.

Experimental Colour Television

The B.B.C. has recently taken delivery, for experimental purposes, of a complete colour television camera chain made by Marconi's Wireless Telegraph Co., Ltd. This is the first order the Corporation has placed for colour television camera equipment, and will provide an all-electronic compatible system (i.e., suitable for black-and-white as well as colour transmission). The equipment has been given a 1,000-hour operational test without a change of camera tubes. The B.B.C. is to use the new camera chain for transmissions of a purely experimental nature. The Corporation emphasizes that these will be conducted for the compiling of technical information and will have no entertainment value.

Continental Link

The opening of the first section of the permanent television link between this country and the Continent took place on 15th September. When completed it will enable Great Britain to participate in the international exchange of television programmes in a much simpler manner than has hitherto been possible. For controlling incoming and outgoing programmes over the European link the B.B.C. has established a new Continental Control Centre in Broadcasting House, London. To supply the power for operating the equipment in this Control Centre 0·0225 sq in of varnished cambric insulated cable manufactured by W. T. Henley's Telegraph Works Co., Ltd., has been used.

Education for Research

The Federation of British Industries has issued a report of the fourth conference of industrial research directors and managers which was held in April-May this year on "The Education and Training of Graduate Staff for Industrial Research" under the auspices of the F.B.I. Industrial Research Committee. The six ordinary papers which were presented at the conference are reprinted in the report in full, while the discussions are given in summary form.

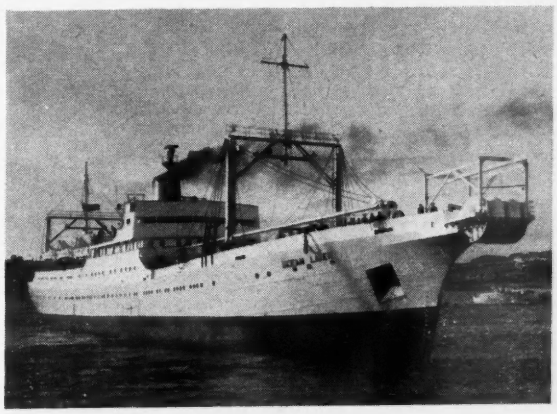
The papers are as follows:—"First Degree Courses in Science and Technology at the University," by Professor E. G. Cox, F.R.S., Professor of Inorganic and Structural Chemistry, University of Leeds, and Professor J. A. Pope, head of the Department of Civil and Mechanical Engineering, University of Nottingham; "The Selection and Training of Graduate Research Staff in Industry," by Mr. C. Paine, director, Imperial Chemical Industries, Ltd., and Mr. O. W. Humphreys, director in charge of research, General Electric Co., Ltd.; "Post-graduate Training at the University," by Professor H. W. Melville, F.R.S., head of the Department of Chemistry, University of Birmingham, and Professor A. J. S. Pippard, F.R.S., Professor of Civil Engineering, Imperial College of Science and Technology, University of London. The report is available from the F.B.I., 21, Tothill Street, London, S.W.1, at 4s.

Irish Electricians' Wages

A new 4d an hour wage increase for 2,500 Irish electricians came into operation on 30th September, ending nearly two months of negotiations between the Electrical Trades Union, the Electrical Contractors' Association and the Society of Irish Electrical Traders. The increase was announced by the E.T.U. which caters for most of the men. The new rate has been set as the ruling rate for electricians.

C.S. "Ocean Layer"

Britain's newest cableship was formally named *Ocean Layer* at a ceremony at Pembroke Dock on 29th September, by Mrs. J. N. Dean, wife of the chairman of the owners, Submarine Cables, Ltd. Built in 1948 as a dry cargo ship, the single-screw *Ocean Layer* has just completed her sea trials after conversion into a cableship by R. S. Hayes (Pembroke Dock), Ltd. Of 4,800 tons deadweight and 378ft in length, she is the world's second largest cableship and is the first British ship to be fitted with a Pleuger active rudder. This device consists of an auxiliary propeller housed in the pear-shaped rudder blade and is designed to increase the vessel's manœuvrability—an essential feature in cable laying operations. The vessel has a service speed of 11 knots and will be commanded by Captain Joseph Marshall. Her full complement will comprise 81 officers and men. Ample accommodation designed for the comfort of the ship's crew has been provided and special attention has been paid to the system of ventilation to ensure a comfortable temperature under varying climatic conditions. The ship can carry upwards of 2,000 nautical miles of deep sea type cable, and she is capable of laying long cables incorporating the latest underwater repeaters in one operation, and of recovering and repairing existing cables at any depth in any part of the world. Her modern cable handling gear and testing equipment incorporates the latest electronic control devices, as well as the most up-to-date navigational aids. Her maiden voyage will be an expedition to the Skagerrak to lay the 67 nautical mile telephone cable between Norway and Denmark next month.



The C.S. "Ocean Layer"

Y.E.B. Staff Conference

Last week the Yorkshire Electricity Board held two conferences at Leeds University. Each was attended by the chairman, deputy chairman, some part-time members of the Board, chief officers and sub-area managers and by about 130 delegates from all parts of the Area. The delegates were chosen from the senior staff of all departments, particularly those controlling large numbers of other employees. They were asked to study, before attending the conferences, a set of papers prepared on the Board's organization in relation to the fulfilment of their statutory obligations and responsibilities.

The papers dealt with the administration, organization and executive management of the Board and the creation of conditions which would give each employee knowledge of, and interest and pride in, the undertaking, so providing a satisfactory service to the consumer. After an introductory address by the chairman, each conference was divided into thirteen groups of ten persons who spent the rest of the morning discussing the conference papers and the organization and

operations of the Board. At the afternoon session the chairman of each group presented a report to the conference, after which the chairman of the Board dealt with all the points raised in these reports.

The conferences coincided with the publication of the Board's annual report and a film which had been prepared based on the Board's activities with particular reference to the results and progress disclosed in the report was shown to each conference.

English Electric's "Gaiety" Site

The English Electric Co., Ltd., has asked Dr. Charles Holden to submit a design for a new building on the Gaiety Theatre site, at the West End of the Aldwych, where it joins the Strand. When the site was originally acquired by the company Dr. Holden submitted designs for the building which was to be erected there. It was decided subsequently to hold an architectural competition and the adjudicators gave first place to the design submitted by Mr. Gordon Tait, of Sir John Burnet, Tait & Partners.

The English Electric Co. says that a period of very careful consideration and appraisal by those concerned followed in which the harmony between the contrasting styles of the existing buildings and that of Mr. Gordon Tait's design featured largely. In consequence, the company decided to ask Mr. Gordon Tait if he would consider creating another design, on a peripheral, as distinct from the spinal, plan upon which his prize-winning design had been based.

Mr. Tait, while appreciating the reasons for this request, decided that he would prefer to free the company to engage another architect for the project. The negotiations were conducted in the friendliest manner on both sides, since all parties were aware that the discussion centred round the eventual appearance of the Aldwych site as a whole and did not affect the company's deep appreciation of both the practical and the æsthetic qualities of Mr. Tait's design.

India's Plant Manufacture

The New Delhi correspondent of the *Financial Times* states that it is reported that the Indian Government has decided to appoint Associated Electrical Industries as consultants for its proposed heavy electrical equipment plant. A.E.I. will advise on the erection and equipment of the plant and on details of design and manufacturing methods.

Kariba Water Power Contracts

Recalling that in June the Government of the Federation of Rhodesia and Nyasaland authorized the placing of contracts to the value of £1·5 million in connection with the Kariba Gorge hydro-electric scheme, the *Board of Trade Journal* says that last month preliminary statements for the use of tenderers for the main civil engineering contract were published. It is hoped to issue invitations to tender by the end of the year and three months will be allowed for the submission of tenders.

There will be separate contracts for the hydraulic equipment, gates, valves, screens, mechanical and electrical plant. Preliminary documents are being prepared and tenders should be invited early next year. Information about the various contracts can be obtained from the Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Room No. 805; telephone: Chancery 4411), or from the consultants, Sir Alexander Gibb & Partners, Queen Anne's Lodge, Westminster, London, S.W., or Merz & McLellan, 32, Victoria Street, London, S.W.1.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £171 0s 0d
COPPER, H.C. Electro	ton £370 15s 0d
Fire Refined 99·70%	ton £369 0s 0d
Fire Refined 99·50%	ton £368 0s 0d
COPPER Tubes ..	lb 3s 6¼d
Sheet	ton £439 10s 0d
H.C. wire and strip ..	ton £416 5s 0d
LEAD, English ..	ton £107 15s 0d
Foreign	ton £106 0s 0d
MERCURY	flask £92 0s 0d
TIN, block (English) ..	ton £747 15s 0d
ZINC, G.O.B. Foreign	ton £91 15s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 9¾d
Sheet	ton £343 0s 0d
Wire	lb 3s 5d
PHOSPHOR BRONZE Wire	lb 5s 1½d
PLATINUM	oz £29 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 38¼d—38½d

Quick Delivery

The Dale Electric (Export), Ltd., was called upon on Monday morning, 26th September, by the Crown Agents to supply seven 3 kVA generating sets for Barbados hurricane relief, the units to be shipped on a specially chartered steamer sailing from London at noon on 28th September. Part of the material was in stock, but the engine power units had to be collected from a sub-contractor in the Midlands and arrived at the factory during the night of Monday. Work on the construction of the generator sets commenced during the afternoon of Monday and continued for thirty hours, the sets being completed at midnight on 27th September. The sets were of the portable type embodied in tubular steel frames with canvas covers affording weatherproof protection.

Electric Fires

In the Domestic Equipment Survey dealing with electric fires (23rd September issue) the prices of the Mysto Maid Electrical Appliances models should have read: "Benbow" 1202, £1 18s 6d plus 14s 1d purchase tax; "Linnet" 1130, £3 9s plus £1 9s; bowl fire 1001, £1 19s 11d plus 14s 8d; and bowl fire 1001C, £2 3s plus 15s 5d. The company also manufactures a bowl fire 1002 in polished aluminium which retails at £1 9s plus 10s 8d purchase tax.

In the Falkirk Iron Co.'s range, models number 39 and 41 are now being offered at £1 19s and £2 18s respectively, and not £2 6s and £4 as shown.

New Fenner Branch at Luton

A new branch of J. H. Fenner & Co., Ltd., at Luton was declared open by the president of the Luton Chamber of Commerce, Mr. J. L. Dickenson, on 3rd October, when an exhibition of the company's products also opened for a period of two days. The new premises occupy the corner site of Guildford Street and Bute Street, and are thus well placed for the convenience of customers. Mr. D. Aslen, home sales manager, welcomed the guests, who included industrialists, engineers and buyers in the Luton area. Mr. E. C. Boddy is responsible for the branch.

Advertisement Correction

In the advertisement on page 104 in our last week's issue of the Atomic Energy Research Establishment, Harwell, for engineers grade III the salary offered was incorrectly given. This should have read £728 at the age of 25 to £1,150 per annum.

Arc Furnace for South Africa

An order has recently been placed by the South African Iron & Steel Industrial Corporation, Ltd., for a 60/65 ton Efco-Heroult arc furnace rated at 15 MVA. Features that have come to be regarded as standard on large arc furnaces (transformer on-load tap change mechanism and air blast switchgear for example) will be incorporated, but there are also a number of new design features that are worthy of mention.

The furnace body and the back structure are mounted on a common chassis but are not otherwise connected together. The back structure, consisting of electrode arms and masts and the roof lifting gear, is mounted on a bogie which rotates about a pivot for roof slewing. Only the roof is lifted before slewing so less effort is, therefore, required and, consequently, less maintenance.

The furnace body is removable from the chassis and this enables an electromagnetic stirrer, the use of which with large arc furnaces is becoming more and more popular, to be relatively easily fitted and maintained; it also enables a spare body to be easily and rapidly installed. Pneumatic counterbalance is used on the electrodes, thereby avoiding the high inertia resulting from counterbalance weights

and the complication of torque motors.

The complete equipment will be supplied by the Electric Furnace Co., Ltd., the furnace itself being built in South Africa, by the East Rand Engineering Co. under the supervision of the Electric Furnace Co.'s agents, D. Drury & Co., Ltd. The main electrical equipment will be manufactured in England by the English Electric Co., Ltd.

Nursing Exhibition

"Electricity Nurses the Nurse" will be the theme of the British Electrical Development Association's exhibit at the 40th annual Nursing Exhibition which opens next Monday, 10th October, at the Seymour Hall, London, W.1.

As a contrast to the technical medical apparatus shown on most of the stands, the E.D.A. display will show how domestic electrical appliances can make life easier for the nurse, midwife and patient. One of the latest automatic electric cookers will be displayed, together with other electrical appliances suitable for nurses' quarters in hospitals, including washing machines, irons, kettles, portable fires and radio sets. Showcards will stress the desirability of the hospital authorities providing an adequate number of plug points in nurses' quarters to enable more of these comfort-aiding appliances to be used.

The exhibition, which closes next Friday, 14th October, is organized by the *Nursing Mirror*, Dorset House, Stamford Street, London, S.E.1.

Lamp Colour-Coding

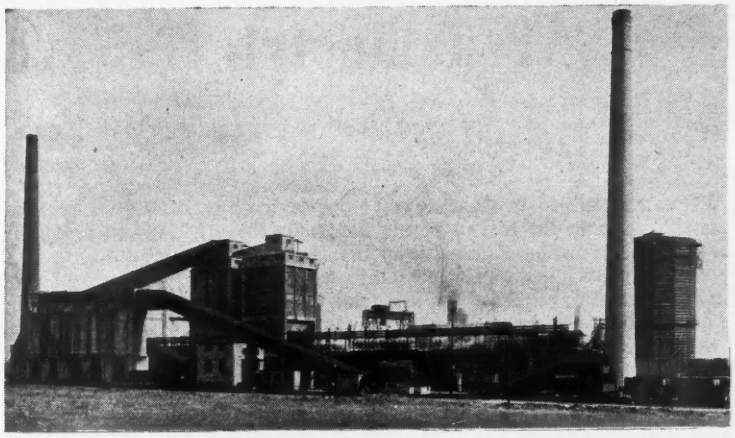
Siemens Electric Lamps & Supplies, Ltd., has issued a descriptive brochure and code key wall chart relative to its new system of colour-coding for fluorescent tubular lamps.

New Coke Oven Installation

On 22nd September the Minister of Fuel and Power, Mr. Geoffrey Lloyd, officially opened the new extensions to the coke oven installation at the Ilkeston works of the Stanton Ironworks Co., Ltd.

The original coking installation at this works, which was built in 1939, consisted of a battery of 41 Woodall Duckham Becker combination regenerative ovens designed to carbonize 860 tons of coal per day. In 1947 technical developments were introduced, the chief of which was the oiling of the coal, which resulted in the throughput being increased to about 960 tons of coal per day. In addition, gas purifiers, producers for dilution gas, gas-drying plant and boosters were installed to handle 6½ million cu ft of gas per day sold to local gas undertakings. Two years later a primary crusher was introduced into the system to enable run-of-mine and graded coal to be blended.

The layout of the original batch of coke ovens was designed to allow the plant to be doubled at some future date, and in 1951 it was decided to carry out this extension at the same time incorporating blast furnace gas cleaning units at the company's two blast furnace plants. As a result of this latter installation clean blast furnace gas became available for underfiring the original ovens. The substitution of this for the coke oven gas used for the two took place in September, 1954.



The Stanton coke oven plant showing the blending and storage bunkers, the oven battery and gas holder

American Control Gear to be Made in United Kingdom

A new range of electrical control equipment is to be made in Britain by a newly-formed subsidiary of the Square D Company, of Detroit, U.S.A. The new company, Square D, Ltd., has its headquarters at 100, Aldersgate Street, London, E.C.1. Branch offices are to be established in important provincial centres and the British company will also serve selected export markets.

Announcing the formation of the subsidiary, Mr. F. W. Magin, president of the Square D Company, states that in the initial stages, selected motor control items from the company's American range of electrical distribution and control equipment will be manufactured for Square D by the Plessey Co., Ltd. Arrangements are also being made to establish stocks of completed equipment and component and service parts.

The directors of Square D, Ltd., are Messrs. F. W. Magin, F. H. Roby and J. F. Magin, of the parent company, and Messrs. B. C. Spicer and R. P. Chambers, of the United Kingdom.

E.A.W. Activities

This autumn will mark the opening of a new campaign by the Electrical Association for Women entitled "Planning for Light." The 156 Branches will be studying domestic lighting in all its aspects, by means of lectures, discussions and study groups as well as by visits to see examples of up-to-date lighting.

The Altrincham Branch of the Association was formed at a meeting on 27th September when the chair was taken by Mrs. H. Walsh, chairman, N.W. England, N. Wales and Merseyside Area Federation. The chief speaker was Miss Nona Baker, M.B.E., branch development secretary, E.A.W. Headquarters, and other speakers were Miss N. Kenyon, member of the North Western Electricity Board, and Mr. W. F. Jarvis, A.I.E.E., A.M.I.I.A. (North Western Electricity Board). The hon. secretary of the new branch is Miss M. Donaldson, and the hon. treasurer Mrs. W. Elliott.

Change of Name

Worboys Electrical Installations, Ltd., has changed its title to Worboys Electrical Co., Ltd.

Trade Announcements

Parnall (Yate), Ltd., announces that the Thor-Parnall showrooms and offices at 64-66, Oxford Street, W, have been closed. All communications should be addressed to Parnall (Yate), Ltd., 255, North Circular Road, London, N.W.10, pending the opening of new premises.

A. M. Lock & Co., Ltd., electronic engineers, of Chadderton, Oldham, are extending their organization to meet the increasing interest in electronic devices in the North. New offices have been opened at Prudential Buildings, 79, Union Street, Oldham, to accommodate the sales and accounts division. Arrangements are being made to establish a Sales and Service Department in Birmingham.

Clarkson (Engineers), Ltd., have opened a new office and stockroom at 17, Cumberland Street, Bristol, 2 (telephone: Bristol 2-8464).

The London offices of the **Geigy Co., Ltd.,** are now at 42, Berkeley Square, W.1 (telephone: Hyde Park 9416).

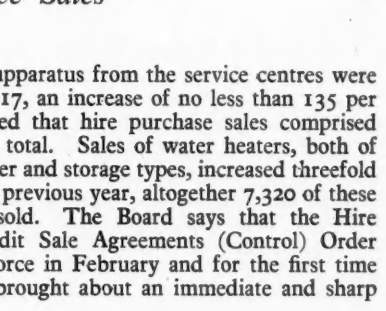
Area Electrical Development

Large Increase in Domestic Appliance Sales

TWO factors helped to make 1954-55 one of the most successful years in the history of the Electricity Boards. One was the stimulation of domestic appliance sales following the withdrawal—unfortunately only temporarily—of restrictions on hire purchase facilities, and the other was the general improvement in load factor mainly as a result of weather conditions but also in part consequent upon the development of off-peak loads.

Compared with the brief cold spell in 1953-54, the severe weather last winter lasted almost continuously from the end of January until the end of March, and the growth of consumption more than matched the rise in maximum demand. For the country as a whole the m.d. actually supplied was 16,611 MW on 13th January, though the estimated potential demand, i.e. including demand not supplied owing to load reduction, was computed as 17,200 MW on the morning of Thursday, 20th January. The accompanying table shows that simultaneous m.d. in the individual areas occurred between 13th January and 24th February. Seven Boards experienced their m.d. in the morning, five in the afternoon and one at mid-day.

While increases in m.d. were in the majority of cases under 10 per cent, ranging from 0·2 per cent (South Eastern) to 16·6 per cent (S.E. Scotland), sales of electricity expanded at rates ranging from 8 per cent (London) to 19·6 per cent (South Western). This was the second year in which the South Western Board recorded the highest proportionate gain. In its largely agricultural area there is limited scope for industrial development, so that the rise of 35 per cent under this heading is particularly noteworthy. Good progress was also made in domestic supplies, the rise of 10 per cent comparing with an average of 3·6 per cent for the past three years. The Board reports that the demand for domestic appliances was higher than ever before; sales increased in value by 50 per cent and nearly twice as many water heaters and washing machines were installed as in 1953-54. Even more striking is the expansion shown in the North Eastern Board's report. Sales of electrical apparatus from the service centres were valued at £1,688,617, an increase of no less than 135 per cent and it is noted that hire purchase sales comprised 80 per cent of the total. Sales of water heaters, both of the immersion heater and storage types, increased threefold compared with the previous year, altogether 7,320 of these appliances being sold. The Board says that the Hire Purchase and Credit Sale Agreements (Control) Order which came into force in February and for the first time included cookers, brought about an immediate and sharp recession, though there was some improvement in the last two weeks of the financial year.



Sales of domestic electrical appliances in the Merseyside and North Wales Board's Area were doubled in value last year, as shown in this graph

Substantial increases in contracting work and appliance sales are also reported by other Boards. In London the turnover rose by 25 per cent, the number of cookers sold being 28 per cent and water heaters 105 per cent greater than in 1953-54. Total sales by the Merseyside and North Wales Board amounted in value to £1,713,000 as compared with £849,000, and again the most marked improvement was in cookers, water heaters and washing machines. The Midlands Board, which introduced a scheme under which electrical contractors co-operate with the Board in the selling and installation of cookers on agreed terms, reports the sale of 25,067 cookers, 16,477 water heaters and 17,978 washing machines. In South Wales, likewise, further arrangements were made for collaboration with contractors and a graph in the Board's report indicates substantial increases in sales of major appliances.

A simple hire scheme was introduced in S.W. Scotland in September, 1953, and since that date 16,568 cookers have been installed on hire, 12,428 during the year under review. The Board in its report points out that the introduction of the scheme does not appear to have seriously affected the numbers of cookers sold for cash and on hire purchase which, at 3,165 and 3,420, respectively, were much the same as in the previous year. The hire scheme also covers cooker circuits (6,217 on hire at the end of the year) and wash boilers (7,836) and was extended last year to include 1½ gal

SIMULTANEOUS MAXIMUM DEMAND AND LOAD FACTOR

Board	Maximum demand MW*		Time		Load factor, per cent	
	1953-54	1954-55	1953-54	1954-55	1953-54	1954-55
London	1,745	1,776	5.30 p.m. 3/2/54	5.30 p.m. 17/1/55	37·5	40·4
South Eastern	972	973	6–6.30 p.m. 1/2/54	5–5.30 p.m. 13/1/55	40·1	44·2
Southern	1,080	1,159	8.30 a.m. 3/2/54	5.0 p.m. 13/1/55	42·4	44·5
South Western	544	595	12.30 p.m. 4/2/54	12.30 p.m 24/2/55	41·2	44·9
Eastern	1,487	1,563	5.30 p.m. 2/2/54	5.30 p.m. 20/1/55	42·5	45·0
East Midlands	1,239	1,321	8.30 a.m. 8/2/54	8.30 a.m. 14/1/55	44·1	46·1
Midlands	1,681	1,769	9.0 a.m. 5/2/54	9.0 a.m. 13/1/55	43·1	45·6
South Wales	709	791	†	†	58·6	59·1
Merseyside and North Wales	834	915	9.0 a.m. 2/2/54	5.30 p.m. 17/1/55	48·9	51·3
Yorkshire	1,532	1,647	8.30 a.m. 29/1/54	10.0 a.m. 17/1/55	46·2	47·6
North Eastern	833	886	11.30 a.m. 11/2/54	8.30 a.m. 14/1/55	51·4	52·6
North Western	1,781	1,883	8.30 a.m. 2/2/54	8.30 a.m. 17/1/55	44·5	46·0
S.E. Scotland...	337	393	8.30 a.m. 2/2/54	8.30 a.m. 17/1/55	45·4	43·8
S.W. Scotland	811	892	8–9.30 a.m. 2/2/54	8–9.30 a.m. 17/1/55	44·1	45·2

* Net purchases from Central Authority and other Area Boards.
† Not stated.

water heaters and also immersion heaters and circulators.

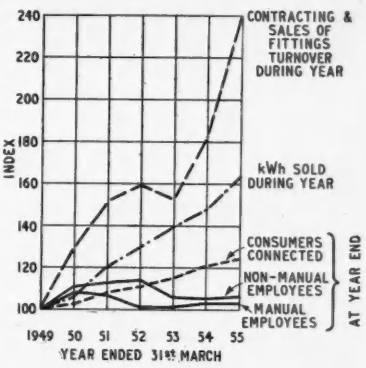
Several Boards refer to the success of their efforts to encourage the development of off-peak loads. Among the larger contracts in S.E. Scotland was that for heating the College of Agriculture, Edinburgh, by a 1,128 kW under-floor system, in addition to which there will be a water-heating load of 200-300 kW. A school and health centre at Innerleithen being built by the Peeblesshire County Council will be designed to give comfort effect against an outside temperature of 20 deg F. Arrangements have been made for the connection of a further 1,500 kW of concrete block storage heaters, one of the largest installations being in an Edinburgh hotel which will have 200 kW of block heaters, a water heating load of 350 kW and a cooking load of 180 kW. In S.W. Scotland, 133 off-peak supplies with loads totalling 13,069 kW were approved during the year, in addition to supplies under the restricted-hour tariff.

Progress in the development of off-peak storage heating is also reported by the South Western Board, which says that during the year many more firms have turned to this form of heating for shops and offices; in Bristol and Bath alone there are already some 120 installations with a total load of 2,000 kW. Both the block type and under-floor systems are in use in the Board's newest service centres. A number of the North Western Board's service centres also have concrete block type thermal storage heaters, and electric floor warming installations in the Area include one in a new motorcar showroom in Manchester. A large office block at Wythenshawe has a thermal storage system of space heating, hot water supplies and kitchen steam.

Electricity on Farms

Rural electrification has been greatly accelerated, especially in the North Eastern Area where 1,483 new supplies to farms were provided compared with 649 in the previous year. The highest number of new farm connections, however, was achieved by the Merseyside and North Wales Board, namely, 1,739—a record for the Area. Figures for other Boards include: East Midlands, 1,504; North Western, 1,131; Eastern, 1,294; South Wales, 1,311; Yorkshire, 1,320; and Southern, 1,164. At 1st April, 1954, the South Western Board changed from the line rental method of charge to a new rural development contribution system consisting of a standard scale of connection charges irrespective of distance from the mains.

The high rate of industrial activity throughout the year is reflected in electricity consumption under this heading, which rose by 12·8 per cent to 32,063 million kWh, representing rather more than half the total sold to all classes of consumers. The South Wales Board, some four-fifths of whose sales went to industry, organized three-day conferences and exhibitions in Cardiff and Swansea to demonstrate how electronics can aid productivity. Mechanization and reorganization schemes being carried out by the National Coal Board have brought substantial load additions to several Boards. In the South Yorkshire coalfield the N.C.B.'s plans involve complete electrification of the larger pits and during the year supplies amounting to 78,600 kVA were approved, calling for the construction by the Yorkshire Board of 66 kV primary substations at or near the collieries. In this Area the Central Authority is to establish a 60 MW generating station at Grimethorpe to burn low-grade fuel.

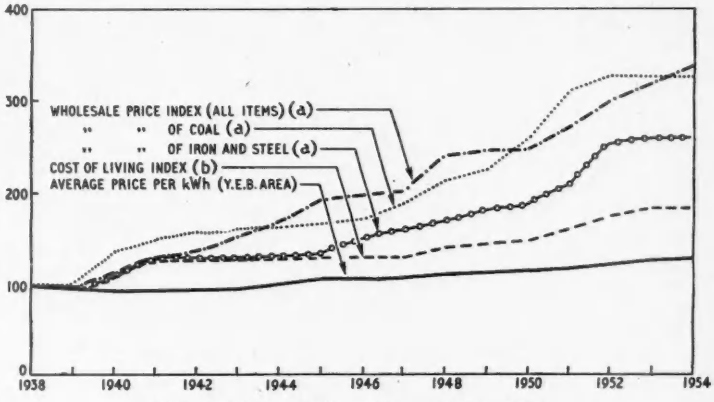


Growth of activities in the Eastern Area contrasted with the smaller number of persons employed by the Board

In the East Midlands new or additional colliery supplies totalling 25,000 kVA were negotiated. New mining supplies agreed with the North Eastern Board (13,000 kW) represent an estimated annual consumption of 56 million kWh. Four of the six electrically operated 20-25 cu yd excavators in the country for opencast operations are in use in this Area. A considerable amount of colliery generating plant is being closed down in South West Scotland and supplies taken from the Electricity Board; so far, 9,600 kVA of plant has been abandoned and work on hand will see the closing down of a further 19,250 kVA. Mining load in South East Scotland, which amounted to 16,000 kVA in 1948, had risen to 55,000 kVA at the beginning of this year and projects in hand are expected to increase this figure to 150,000 kVA within a few years.

The improvement of street lighting, with conversion from gas to electricity, was accelerated. The South Eastern Board connected 5,213 lighting points, 26 per cent more than in any previous year. The North Western Board connected an additional 13,489 lamps, the North Eastern 8,034, Yorkshire 10,436, London 5,746, and similar good progress is reported by other Boards. The South West Scotland Board says that at the end of March last 84 per cent of the public street lamps in its Area were lit by electricity.

For the most part retail tariffs remained unchanged during the year, though some further headway was made with standardization. Revenue per kWh sold was actually slightly less than in 1953-54 (1·370d against 1·373d), the London, Southern, South Western, Eastern, Merseyside & North Wales, and Yorkshire Boards all recording decreases. The Yorkshire Board graphically compares the small increase in electricity charges in its Area since 1938 with the sharp rise in other costs. The Merseyside &



Comparision of the price of electricity in the Yorkshire Area and the rise in costs generally

(a) Board of Trade; (b) Ministry of Labour and National Service

North Wales Board points out that in spite of an increase in the cost of electricity purchased total expenses fell by 0·021d to 1·255d and other Boards also report reductions in the costs within their control—Seeboard, for the fifth consecutive year. The Eastern Board shows, by a graph, that despite the expansion of its activities the number of employees is less than five years ago.

Among administrative matters dealt with, the London Board's report refers to the decision to extend the two-tier system throughout its area, the date of its application to the remaining sub-areas being to some extent dependent on the progress of building construction to provide suitable accommodation.

To meet the constantly increasing demand for electricity, distribution systems have been considerably reinforced and extended; e.g. capital works carried out by the Eastern Board last year amounted to £8,210,506 against £6,903,413 in 1953-54. Progress is also reported by most Boards in the change-over from d.c. to a.c. and in the conversion of non-standard voltage systems.

Combination Rolling Mill

TO meet the need in this country for a truly versatile ferrous and non-ferrous metal reducing plant, American-designed "Stanat" machines are now being manufactured under licence by a British firm. The equipment, known as "Stanat-Mann" two-high/four-high combination rolling mills, is available as 1½in and 5in by 8in, and 2¼in and 8in by 8in sizes.

Designed to accomplish the work of two or more mills, this new heavy-duty machine can be used for bar, rod and strip reduction. In one compact machine, the mill performs the following functions: (a) hot flat rolling; (b) cold flat break-down; (c) cold flat finishing on either a two-high or a four-high set-up; and (d) hot or cold rolling of wires and shapes. To make the change from two-high to four-high, the large rolls are separated and two smaller work rolls are inserted between the large ones, which then become "back-up" rolls.

Above: Two-high arrangement of combination mill with grooved rolls installed and (right) change-over from two-high to four-high arrangement is made by inserting work roll assembly

When functioning as a conventional two-high unit, the relatively large work roll diameter of the mill is valuable for the break-down of ingots and bars, the reduction of high lustre strip, and for the skin-passing of annealed strip. Because a larger work roll diameter causes greater slipping between the roll surface and the material, bright and highly burnished surface finishes can be obtained when reducing annealed strip. An added advantage of the larger work roll diameter is its greater circumference which reduces wear, thus improving performance and lengthening work life between grindings.

In flat rolling, the prime advantage of the four-high configuration is that with a given roll load capacity and mill horsepower, greater reductions may be taken with the smaller diameter work rolls. Furthermore, in rolling the harder metals and alloys, the smaller work roll reduces the lateral spread, and hence the tendency of the strip edges to tear or crack. The "stiffness" of the backed-up four-high mill and the ease with which its small work rolls can be "crowned" makes possible the production of extremely accurate strip having practically no thickness variation across its width. The smaller work roll facilitates thinner strip finishing gauges even in highly work-hardened materials, since the length of the flattened arc of contact between the work rolls and the material decreases with the decrease in work roll diameter. The roll loads and rolling torques can be reduced even further by employing solid tungsten carbide work rolls.

Depending on the required range and speeds of reduction, the two-high/four-high combination mill can be powered by a constant-speed or a four-speed gear-shift a.c. drive, or a variable-speed d.c. drive. The mill motor is mounted in the unit base of the machine and drives the pinion stand through double-helical reduction gearing. The pinions drive the two large-diameter rolls through silent universal spindles.

The method of providing front and back strip tension can be varied in accordance with maximum strip pull requirements and coil build-up ratios. In the simplest arrangement on a non-reversing mill, back tension is applied by a friction brake on the pay-off reel, and variable front tension is obtained by driving the coiling reel from the main mill motor through an adjustable slip clutch. Reversing mills can be equipped with a variable-voltage d.c. drive, permitting of very precise tension control. The improved reductions and strip flatness obtainable with the application of front and back tensions permit the successful cold-working of thin, hard metals.

These combination rolling mills are made by Albert Mann's Engineering Co., Ltd., of Basildon Industrial Estate, Essex.

CLEAN AIR

National Smoke Abatement Society's Conference

THE twenty-second annual conference of the National Smoke Abatement Society was held at Bournemouth from 28th to 30th September. In his presidential address Sir Ernest Smith claimed that the recommendations of the Beaver Report, which formed the basis of a forthcoming Act of Parliament, were largely an elaboration of the views of the Society. The success of the Act would depend upon the active collaboration of the Government, local authorities and the public. The Society would provide independent criticism of the working of the Act by those responsible and would continue its educational and publicity activities.

While the Bill proposed that the more difficult technical problems should be dealt with by increasing the number of alkali inspectors at a cost of £40,000 a year, inspectors would be required by local authorities also entailing further expenditure. That expenditure would be well worth while, as air pollution in a town of 50,000 inhabitants had been estimated to cost some £500,000 per annum and it was not restricted to the area that was responsible for it.

The growing problem of fumes from road vehicles, particularly those with badly adjusted and operated diesel engines, was not covered by the new Clean Air Bill because it was dealt with by the Road Traffic Act and was the responsibility of the police, who might well be more aggressive in this matter. If the higher price of fuel compelled more efficient use, it might yet prove a blessing in disguise.

District Heating Costs

The Westminster City Council's district heating scheme furnished the subject for two papers. The first, by Alderman C. P. Russell, described the undertaking from its initiation to the present time. To-day, space heating and hot water was supplied, he said, to 1,054 flats and other dwellings in Churchill Gardens owned by the Council and 1,200 flats in Dolphin Square; a further 837 flats, etc., in Churchill Gardens and Abbots Manor would eventually be connected. The Council's tenants of 1,030 flats paid for the service 4s 10d per week for a single-room flat up to 14s 2d for a five-room flat, which produced a revenue of £29,000 during the year ended 31st March last, and other tenants paid according to the estimated amount of heat made available. The landlords of the Dolphin Square premises purchased heat from the Council paying an annual sum and an additional charge for each metered therm. Charges recovered from occupiers amounted to £45,100. Costs incurred by the Council were: capital charges on £250,000 (e.g. for mains and pump house) amounting to £11,800; working costs, £42,300; total per annum, £54,100. Total cost of heat purchased from Battersea power station was 9·33d per therm. On completion of the scheme annual capital charges were estimated to be £16,300 on £300,000 and working costs £57,000, making the undertaking self-supporting.

Designed temperatures of living rooms were 65 deg F and of bedrooms 60 and 55 deg F (according to the estate) with an outside temperature of 30 deg. In practice, temperatures on an average were nearer to 70 deg, especially in the evenings. Although the heating system was shut down from 11.30 p.m. to 6 a.m. the temperature drop at night was only 2 to 3 deg. Hot water, averaging 15 gal/head/day, was provided at 130 to 135 deg F from bulk calorifiers in basements. The heating season extended from 1st October to 30th April but was modified according to the weather.

Conditions in Westminster were peculiarly favourable to the success of the scheme which had been in operation for five years. These conditions included the nearness of Battersea power station, the existence of a tunnel under the river and of a nucleus of 1,200 flats in Dolphin Square.

Engineering aspects of the Westminster district heating undertaking were presented by Mr. Bryan Donkin (Kennedy & Donkin), who said that excess heat from the exhaust of the two 1,350 kW back-pressure turbines in Battersea power station was stored in an accumulator for meeting any deficiency in the steam supply to the flats. The combined maximum output of steam at 200 deg F and 2 lb/sq in gauge produced by the turbines, amounting to 455 therms/hr, could meet a peak demand of 750 therms/hr. The sets were run continuously in cold weather and stand-by was provided from the 600 lb/sq in steam mains in the power station through pressure-reducing valves and de-superheaters. No interruption in supply had occurred. Heat insulation of the 12in low-pressure mains was by 2in of cork.

The steel vertical cylindrical accumulator, 126ft high by 29ft inside diameter with a volume of 80,000 cu ft, had an effective storage capacity of 4,000 therms or 5,000 B.Th.U./cu ft, which was ten times that of a cu ft of town gas. The electricity produced, 5 kWh/therm supplied, was purchased by the Central Electricity Authority and the revenue thus obtained reduced the cost to the heat consumers. Experience indicated that a higher electricity-heat output ratio could safely be obtained.

The overall thermal efficiency for electricity and heat generation was 82 per cent. The total saving in coal for the complete scheme was estimated at 3,000 tons/annum with a heat output of 2 million therms. Taking account of the elimination of open fires and other less thermally efficient methods of heating, the coal saving would probably exceed 10,000 tons per annum.

Floor Warming in Scottish Flats

Electrical floor warming, with particular reference to an eight-storey block of 48 flats at Kirkcaldy, was dealt with by Mr. J. W. Moule (South of Scotland Electricity Board), who showed that the use of electricity for space heating could be confined to off-peak periods (including one during the day). The tariff in the instance referred to was 0·7d/kWh and it applied also to a 42-gal storage water heater. The floor heating system consisted essentially of two asbestos-insulated cupro-nickel resistance wires (operated at 180 deg F) enclosed in a lead sheath and joined at the far end. Temperature was thermostatically controlled in the rooms. The resistance cables were laid in aluminium ducts in the concrete floor. No floor heating was provided in the bedrooms and kitchens, reliance being placed upon heat transmitted through the building, but there were power points in every room and a 2 kW electric radiator in each living room for use during extremely cold weather. These power points together with the lighting installation and electric cooker were charged for at the standard domestic tariff. No appreciable heat drop occurred during the five hours following switching off the supply to the floor heaters.

Annual cost of heating was estimated to amount to £24

and £19 for three- and two-apartment flats, including supplementary heating by electric fires. For other services (including hot water) the costs were expected to be £22 and £13. The rewirable type of floor warming described cost £25/kW, including all associated electrical work, for a total loading of 148 kW, i.e. 3 kW per flat, without taking credit for substantial savings in building expenditure. Had the heating cables been directly embedded in the floor, the scheme could have been carried out for £12/kW but the cables (which were very reliable) could not be replaced without breaking up the floor.

The temperature was greatest at floor level (where most required) reaching a maximum of 72 deg F, whereas with convection heating the highest temperature was at ceiling level.

Regarding the industrial aspects of the Beaver Report and the Clean Air Bill, Mr. G. Nonhebel (Imperial Chemical Industries) stated that the British Standards Institution had set up three committees. The first was preparing a specification for an inexpensive instrument to give visual and audible alarm when the density of smoke exceeded a predetermined level coupled with a clock which recorded the total times each day at which this happened. He hoped that a provision would be inserted in the Bill to allow such records of density and duration of smoke to be produced as evidence by a defendant to a court action.

The second B.S.I. committee was concerned with a Code of Practice indicating how smoke could be reduced by good practice and was now making measurements with automatic smoke recorders of the frequency, duration and density of dark smoke during soot-blowing and attention to fires. The third committee was developing a standard method of measuring grit emission.

In a paper on research, Mr. C. J. Regan referred to the Fulham-Simon Carves process for washing flue gases with waste gas liquor, which recovered the sulphur as ammonium sulphate and elemental sulphur. The C.E.A. was constructing a large plant based on a pilot plant at the Fuel Research Station. The ultimate fate of sulphur compounds emitted from chimneys was unknown since measurements so far made accounted for a relatively small proportion.

At the closing session Dr. A. Parker (director, Fuel Research, D.S.I.R.) delivered the Des Voeux Memorial Lecture, taking as his theme the destructive effects of air pollution on materials. In 1954, he said, pollutants discharged into the air from the use of fuels amounted to 2 million tons of smoke, nearly 2 million tons of grit and dust and over 5 million tons of sulphur dioxide. Deposits in industrialized areas might be from 500 to 3,000 tons/sq mile, compared with 100 down to 10 tons in rural areas. In towns the concentration of sulphur dioxide at or near ground level in winter ranged from 5 to 100 milligrammes/100 cu metres. At that level the amount of sulphur-dioxide in the air of towns was generally lower than that of smoke, though the quantity discharged was twice as much. One reason was that low domestic chimneys discharged nearly half the smoke but less than one-fifth of the sulphur. Another was that smoke consisted of fine particles suspended in the air, while the gas sulphur dioxide was more easily mixed with the air at higher levels and was thus diluted and dispersed, travelling perhaps 50 miles or more away. Thirdly, sulphur dioxide, being soluble in water, was more readily removed by absorption in rain or mist on wet buildings and by plants and soil.

The proceedings of the conference also included the presentation of four papers on local authorities' problems in relation to the Clean Air Bill and five on non-electrical aspects.

Argentine Power Problems

FROM OUR CORRESPONDENT

INCREASING attention has been called of late to the acute shortage of electric power in Argentina, specially in Greater Buenos Aires. The Minister of Industry said recently that installed capacity in this area is about 800,000 kW and present peak consumption, which was expected to be 8 per cent higher than in 1954, has already exceeded last year's figure by 25 per cent. At the present rate of increase, and maintaining the existing restrictions on consumption, a shortage of 140,000 kW must be expected in 1956 when, in accordance with the expansion programme, installed capacity is raised to 840,000 kW.

In order to ease the situation the provisions of Circular No. 2033, of August, 1954, "are to be put in force immediately." This seems to imply that it has not yet been made effective, or only partly so. The circular announced that the Central Bank had decided to consider applications for exchange permits to the value of $40 million, through the official market, payable in six annual instalments, for imports of machinery and equipment for production, transformation and distribution of electric power from the sterling area, Japan and specified countries of Western Europe. It was estimated that these imports would allow for an increase of 400,000 kW in installed capacity, of which 50 per cent would be available in Greater Buenos Aires.

The Minister added that the San Nicolas plant (see *Electrical Review*, 22nd April) would supply 200,000 kW to this area by 1957, raising the total capacity to 1,040,000 kW, or approximately 25 per cent more than in 1956. A further increase of 300,000 kW would become available in 1958-59, when plans to extend existing plants had been carried out. The various investment programmes for electrical expansion up to 1960, he said, would cost over 5,000 million pesos, the bulk of the expenditure being in foreign currencies.

The urgency of Argentina's power problem was also stressed by the General Economic Federation in *Informe Economico*. This study estimates that 2,300,000 kW will be required by the end of another ten years, a figure much in excess of the provisions under the second five-year plan. It points out that Greater Buenos Aires contributes 60 per cent of total installed capacity and absorbs 72 per cent of national consumption, which amounted to 5,369·7 million kWh in 1954. Power in this area is now supplied by two companies, with installed capacities of 662,500 and 223,000 kW. The 325,000 kW plant at San Nicolas will transmit at least 150,000 kW to the Federal Capital by 1958, a totally inadequate contribution. Installed capacity, *Informe Economico* suggests, should be raised to 1,800,000 kW in Greater Buenos Aires by 1963 (1953 capacity is given as 895,000 kW), plus renewal requirements and a reserve, say an increase of 1,300,000 kW in all. A 500,000 kW station is indispensable as a start.

The same study estimates the additional needs in the interior at 1,000,000 kW, less the capacity of the plants now under construction, bringing Argentina's total additional requirements up to approximately 2,300,000 kW. The cost, reckoned at 3,000 pesos per kilowatt installed, would be in the order of 7,000 million pesos and, according to the report, could not be provided by the State alone. Facilities should be afforded to private enterprises, in order to induce them to co-operate.

I.E.E. Centre Chairmen

Provincial Officers for 1955-56

IN our last issue we published the portraits and biographies of the chairmen of the specialized Sections of the Institution of Electrical Engineers. We now give below brief particulars together with the portraits of the chairmen of the provincial Centres.

MR. F. BARRELL, M.I.Mech.E., A.M.I.I.A. (North Midland), has been generation engineer (construction) of the Yorkshire Division of the C.E.A. since vesting date, during which time he has been responsible for the construction of the Skelton Grange "A" power station and the Wakefield "B" station, in addition to extensions to a number of other stations. He received his practical training with the Metropolitan-Vickers Electrical Co., Ltd., and J. P. Hall & Co., Ltd., and in 1924 was engineer in the Development Department of the General Electric Co., Ltd., Witton, becoming designer and engineer with that company in 1928. In 1935 he went to Poplar as superintendent of substations and electrical plant in generating stations, four years later becoming chief engineering assistant. From 1941 to 1945 he was deputy chief engineer and manager at Blackburn, and from 1945 until vesting date he held a similar position with the Leeds electricity undertaking.

MR. G. V. SADLER (North Western) is chief electrical engineer and director of the Vaughan Crane Co., Ltd., Manchester. He was educated at Mill Hill School and the City and Guilds Engineering College. He held positions with Lancashire Dynamo & Crypto, Ltd., Laurence, Scott & Electromotors, Ltd., Allen West & Co., Ltd., and Brookhirst Switchgear, Ltd., before joining the Vaughan Crane Co. in 1932. He was awarded the Swan Premium by the I.E.E. in 1948 for a paper on "Electrical Aspects of Overhead Travelling Cranes," and is the author of numerous patents for crane control gear. He was chairman of the North Western Centre Utilization Group of the I.E.E. for 1951-52, and a member of the I.E.E. Utilization Section Committee for 1953-55.

PROFESSOR J. M. MEEK, D.Eng. (Mersey and North Wales), occupies the David Jardine Chair of Electrical Engineering at Liverpool University. He graduated at Liverpool University in 1934 with an honours degree in electrical engineering, and then joined the Metropolitan-Vickers Electrical Co., Ltd., as a college apprentice, later being appointed to the staff of the high-voltage laboratory, where he carried out research on the mechanism of growth of spark discharges. In 1938 he was awarded a Commonwealth Fellowship enabling him to work for two years in the Physics Department at the University of California, Berkeley, United States. Here he made further researches on spark discharges and published a book, written in conjunction with Professor L. B. Loeb, on "The Mechanism of the Electric Spark." Professor Meek returned to the Metropolitan-Vickers high-voltage laboratory in 1940, and continued working there until 1946 when he was appointed to his present position. In 1942 he was awarded the Institution Premium of the I.E.E. for his paper on "The Electric Spark in Air." From 1944 to 1947 he served on the I.E.E. Council as an associate member. Professor Meek has recently published two books, written in conjunction with Professor J. D. Craggs, on "Electrical Breakdown in Gases" and on "High-Voltage Laboratory Technique."

MR. H. S. DAVIDSON (South Midland) is transmission engineer for the Midlands Division of the C.E.A. He received his early training with Drake & Gorham, Ltd., Manchester, and with the Carlisle Corporation Electricity Department, and was subsequently with the Wolverhampton Electricity Department. In 1930 he joined the Central Electricity Board staff and before vesting day was transmission engineer for the Central England Area. He was hon. treasurer of the South Midland Centre of the I.E.E. for six years before becoming vice-chairman. Mr. Davidson is this year's president of the Midland Electrical Engineers' Association, and is a past chairman of the Birmingham Branch of the Electrical Industries Benevolent Association. An officer in the Territorial Army for many years, he saw active service in both world wars and holds the rank of lt.-colonel; he is now commanding officer of a Home Guard battalion. He is a member of the No. 7 District Joint Industrial Council and of several national committees in the electricity supply industry.

MR. F. R. C. ROBERTS (East Midland) has been manager of the Spalding District, East Midlands Electricity Board, since vesting date. After serving an apprenticeship with the Fleetwood Electric Lighting Syndicate, he joined the Cleveland & Durham Electric Power Co., Ltd., in 1914 as a junior engineer and two years later became assistant district engineer with the Newcastle Electric Supply Co. In 1928 he went to Spalding U.D.C. as engineer and manager of the Electricity Department, which position he held at vesting date. Apart from his electrical activities, Mr. Roberts is a member of the Magic Circle and with his wife has performed before the Magic Circle and on closed circuit television at the Manchester Radio and Television Exhibition.

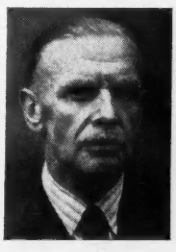
MR. T. G. DASH, M.I.Mech.E., M.I.Min.E. (Western), has spent the whole of his career in the mining industry, and now holds the position of area chief engineer (electrical and mechanical) for the No. 5 Area of the National Coal Board, S.W. Division. After serving his apprenticeship in various collieries, he was appointed electrical engineer in charge of Penallta Colliery in 1923 and in 1928 took up a similar appointment at the Bargoed collieries, washeries, coke ovens and power station. From 1935 to 1945 he was assistant chief engineer (electrical and mechanical) for the Rhymney Valley group of collieries of Powell Duffryn, Ltd., and from 1945 to 1947 was chief engineer (electrical and mechanical) for collieries in the northern area of that company. In addition to his membership of the Institutions mentioned above, Mr. Dash is a Fellow of the Association of Mining Electrical and Mechanical Engineers, and is a Justice of the Peace for the County of Monmouth.

Mr. L. H. FULLER, B.Sc. (Southern), was educated at Wellingborough School and King's College (London

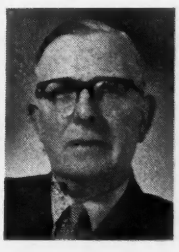
Mr. F. Barrell

Mr. G. V. Sadler

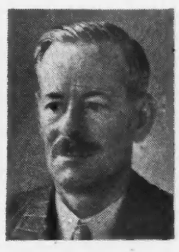
Prof. J. M. Meek



Mr. H. S. Davidson



Mr. T. G. Dash



Mr. L. H. Fuller

Mr. A. H. Kenyon

Dr. E. Wilkinson

Major E. N. Cunliffe

University). After training at Fullers United Electric Works, Chadwell Heath, he joined the Yorkshire E. P. Co. in 1924 as a junior assistant in the Substation Department. Some years later he transferred to the Power Station Construction Department, but returned to substation work, being responsible for substation construction at vesting date when he joined the South Eastern Board as section head (construction) and he now holds the position of an assistant chief engineer responsible for construction work and engineering purchasing. In 1948 Mr. Fuller was the co-author (with Mr. C. R. Clarke) of a paper on "Substations, with Particular Reference to Yorkshire Practice." Mr. Fuller is the fourth generation of his family to be a member of the I.E.E., which he believes to be a record.

MR. A. H. KENYON (North Eastern) has spent the whole of his career in the electricity supply industry. After training with the Accrington Corporation Electricity Department, he became assistant engineer with the Northampton Electric Light & Power Co. in 1929 and in the following year joined the North Eastern Electric Supply Co., where he eventually became administrative assistant to the general manager. On vesting day he was appointed to his present position of Sub-Area liaison officer with the North Eastern Electricity Board.

MR. E. WILKINSON, B.Eng., Ph.D. (Scottish), has held the position of head of the Electrical Department of Robert Gordon's Technical College, Aberdeen, since 1944. He received his education at Liverpool University, and was later (1931-32) with the Heinrich Hertz Institut für Schwingungsforschung, Berlin. From 1934 to 1935 he was in the Electromagnetic Research Department of the Metropolitan-Vickers Electrical Co. and he commenced his teaching career at the Loughborough Technical College in 1935 where he remained until going to Aberdeen. He has taken a special interest in the students' sections of the I.E.E.; while at Liverpool he was hon. secretary of the Mersey and North Wales Students' Section, and later, on the Committee of the North Western Students' Section. He was largely responsible for the inauguration of the Aberdeen Branch of the North Scotland Students' Section in 1951, and he is the senior representative on their Committee.

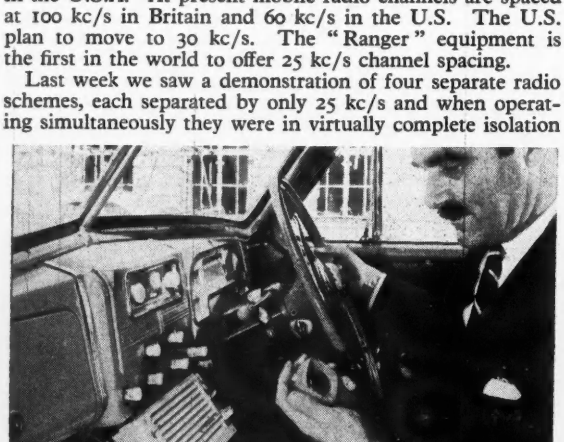
MAJOR E. N. CUNLIFFE, B.Sc.(Tech.), A.M.I.Mech.E. (Northern Ireland), is distribution engineer with the Belfast Corporation Electricity Department, with which undertaking he has been associated in various capacities since 1936. After education at Manchester University, he joined Merz & McLellan, consulting engineers, Newcastle-on-Tyne, in 1928, as assistant engineer, taking up a similar position with Buchan & Partners, Edinburgh, four years later. In 1933 he joined Preston Corporation Electricity Department as assistant engineer (mains), where he remained until going to Belfast. Major Cunliffe was commissioned in the Territorial Army in 1931 and spent much of his time in the last war in the Middle East.

Mobile Radio-Telephones

THERE are now more than 10,000 mobile radio-telephones in Britain and these are operating on a frequency band which is being drastically reduced in size by commercial television. The ever-increasing demand for mobile radio is therefore faced with a decreasing number of channels available for development. To overcome these difficulties a new two-way mobile radio, known as the "Ranger," has been designed by Pye Telecommunications, Ltd., to operate on only a quarter of the frequency space needed by existing equipment.

The specification to which the equipment works is even tighter technically than the new specifications envisaged in the U.S.A. At present mobile radio channels are spaced at 100 kc/s in Britain and 60 kc/s in the U.S. The U.S. plan to move to 30 kc/s. The "Ranger" equipment is the first in the world to offer 25 kc/s channel spacing.

Last week we saw a demonstration of four separate radio schemes, each separated by only 25 kc/s and when operating simultaneously they were in virtually complete isolation from each other. The "Ranger" is designed to give an output of from 4 to 6 W over the frequency range 25 to 174 Mc/s. Additional features include exceptional frequency stability, high sensitivity and signal to noise ratio, rapid changeover from 6 to 12 V operation, with no muting incorporated. Special versions include mute operation, up to 6 channel crystal switching, and public address facilities. All components and valves have been chosen to ensure that the equipment is suitable for continuous operation in any part of the world.



New Pye two-way mobile radio for 25 kc/s channel spacing

Electrical Accidents

IN his address as chairman of the Ipswich and District Electrical Association at its first meeting of the season, at Electric House, Ipswich, Mr. Stanley Hardy discussed the safe use of portable electrical machinery, stressing that it was the duty of everyone connected with industry to eliminate accidents. Mr. Hardy pointed out that in the past four years 65 workpeople had been killed and 1,412 injured as the result of using electrical equipment. Year by year more electrical equipment came into use and the question of safety became more important.

There were three main reasons for electrical accidents: defects in the equipment; carelessness in its use; and putting it to a use for which it was not intended. Three main classes of people should concern themselves about greater safety. Employers should make sure that equipment was of the right type—much domestic equipment could not be expected to stand up to the rigours of industrial use and they should make sure that the equipment was regularly inspected and maintained. Manufacturers should produce equipment for the specific job, so that it could be used without modifications that might lead to trouble. They should be sure that all parts of machinery were well covered; some machines still had parts with only a superficial covering in light brittle plastic. Employees should not place wires carelessly and they should make sure that the equipment was tested before they took it from the works stores. Further, leads and wires should be hung out of people's way.

NEW SODIUM LAMP

Unit with Integral Vacuum Jacket for Street Lighting Duties

By G. D. BRITTAIN, B.Sc., and S. A. R. RIGDEN*

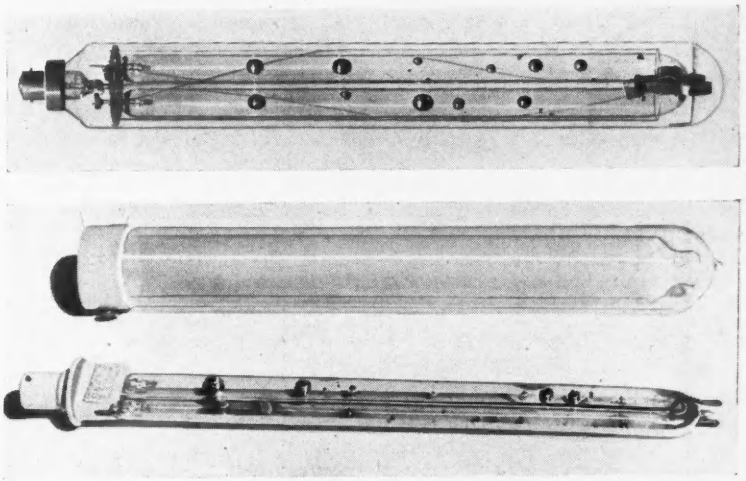


Fig. 1.—The new design of sodium lamp, compared with the current design (below). For the sake of clarity, the gettering process has been omitted

THE past decade has seen an increasing use of discharge lamps for street lighting. The sodium lamp, introduced in England shortly after the mercury discharge lamp, has achieved a wide measure of popularity with street lighting engineers and with motorists, largely on account of its high efficiency on the one hand and its low glare factor on the other.

The efficiency of a sodium vapour discharge lamp depends upon two opposing factors:—the current density (current per unit cross-sectional area of the discharge tube) must be kept at a low value, while maintaining at the same time a relatively high figure for the sodium vapour pressure. An efficient system for heat conservation is thus an important element in any sodium discharge lamp as a low current density tends to result in a low arc tube temperature, making it difficult to achieve the required value for the sodium vapour pressure.

In the current design, an independent vacuum jacket serves to reduce the heat losses as far as possible but this separate component has a number of disadvantages in practice. Development work at the G.E.C. Research Laboratories on a new sodium lamp with an integral vacuum jacket has now reached an advanced stage and extensive trials are at present being carried out to verify the performance of this new design in service.

The adoption of an integral jacket has enabled a number of advantages to be realized, including increased luminous efficiency, greater ease of starting and elimination of humidity effect. The integral jacket provides a useful degree of protection for the discharge tube, and results in improved "handleability," while the greater degree of freedom from early failures, inherent in the new design, will offer even further improvements in reliability.

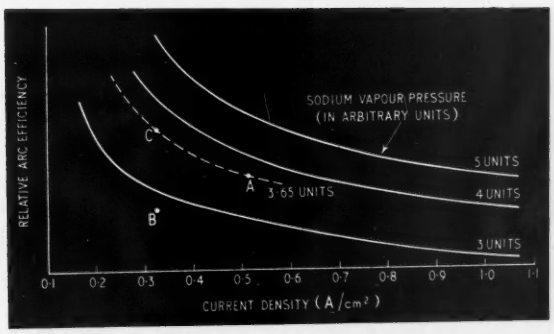


Fig. 2.—The effect of current density and sodium vapour pressure on the relative arc efficiency of a 140 W sodium lamp

(A) Operating point for current design of 140 W lamp with independent jacket
(B) Operating point for arc tube of new design when burning, unsleeved, in conventional separate jacket
(C) Normal operating point for new lamp

The new design of sodium lamp may be compared with the existing type by reference to Fig. 1. The conventional U-shaped arc tube is mounted inside an evacuated tubular bulb and one of the problems to be solved in the design of this new lamp was that of maintaining an adequate degree of vacuum in the outer bulb during the life of the lamp. The separate jacket of the existing design is made solely from glass and can therefore be subjected to a rigorous baking schedule during evacuation. The rate of gas evolution during life is consequently very small, and independent jackets of current design have about three times the life of the lamp itself. With the integral jacket, however, not only are the arc tube and its mountings within the evacuated enclosure, but the presence of the sodium metal in the arc tube imposes severe limitations on the baking temperature during evacuation of the jacket.

The success of the new design springs partly from the development of an effective baking and evacuation schedule for the integral jacket. In conjunction with a suitable gettering agent, the effects of outgassing of the arc tube support components are reduced and a satisfactory vacuum can be maintained in the jacket throughout the life of the lamp. This vacuum enclosure practically eliminates heat losses by convection and gas conduction while the loss of heat by radiation is kept at a low value by the adoption of closely-fitting glass sleeves which surround each limb of the U-shaped arc tube. These sleeves, which are an important feature of the new lamp, absorb infra-red energy from the discharge, some of which is re-radiated back to the arc tube.

These two design factors have decreased the heat losses from the arc tube to such an extent that it has been possible to increase its diameter with a corresponding reduction in the current density, leading to an increase in lamp efficiency.

* The General Electric Co., Ltd.

Although the power dissipated per unit surface area of the arc tube is thus lowered, the improved heat conservation enables the original sodium vapour pressure to be maintained and the ultimate result is a gain in efficiency throughout life of some 10 per cent. Fig. 2 on the preceding page shows the effect of current density, and sodium vapour pressure on the luminous efficiency of the discharge.

The effects of the larger bore adopted for the arc tube and the use of glass sleeves around each of its limbs may be clearly seen. The normal operating point for the current design of sodium lamp with separate jacket is shown at A. Point B corresponds to the operation of the new arc tube, without sleeves, in a standard independent jacket. The increase in arc tube diameter has so reduced the power dissipation per unit surface area of the arc tube, and with it the sodium vapour pressure, that the efficiency is considerably lower, in spite of a reduction in current density of about 40 per cent.

With the glass sleeves in position, however, and the discharge tube operating within the integral jacket, heat losses have been reduced while the arc tube temperature and hence the sodium vapour pressure have been increased. In turn, a higher value of efficiency has been realized, and since points A and C correspond to the same sodium vapour pressure, the improved efficiency can be traced to the lower current density and improved heat conservation made possible by the new design.

The use of an arc tube of the same length but having a greater diameter than that used in current designs has given a further advantage in the form of a reduced tendency for the starting voltage to rise during life. The arc tube is filled with neon together with about 1 per cent of argon. The argon content is an essential factor in achieving a practicable starting voltage but tends to be absorbed by the glass surface of the arc tube during life—a phenomenon known as " argon clean up."

By increasing the bore of the arc tube the effect of the increased surface area is more than outweighed by the greater initial volume of argon and the tendency towards argon clean up is reduced to give a more stable figure for the starting voltage during life, a parameter which is critically dependent upon the argon pressure. Further reductions in starting voltage are made possible by the use of twin " starting wires " which perform a similar function to the metal stripe fitted to some fluorescent tubes for instant start circuits (see *Electrical Review*, 8th April, 1955, pp. 580-1).

This new design, therefore, will provide the user with a sodium lamp of robust construction which will simplify handling, together with a useful increase in luminous efficiency and a greater order of stability in its characteristics during life. The new lamp will be available in the same wattage ratings as are at present in use and the dimensions and electrical characteristics have been chosen to ensure full interchangeability.

Electrical Industries Golf Championship

THE national final meeting of the Electrical Industries National Golf Championship was held on 26th September in Birmingham. The championship itself took place at Sutton Coldfield Golf Club, when the Sir Montague Hughman trophy was won by Mr. F. Warren (Denis Ferranti Co., Ltd.), with a score of 74−12 handicap=62. The runner-up was Mr. F. W. Shaw (South Eastern Electricity Board) with a score of 83−14=69, and the J. Y. Fletcher Cup for the best scratch score was won by Mr. Eric Walton (Neptric, Ltd.), with a gross score of 72. In the afternoon the foursome competition for the Sir Felix Pole cups was won by Mr. P. Richardson and Mr. H. Fletcher with a score of 35 points. The Veterans' Trophy presented by the *Electrical Journal* was won by Mr. A. H. Taylor (Midland Electricity Board) with a score of 38½ points. Some 50 competitors from all areas of Great Britain took part. At Little Aston course near by another ninety players held a competition for the Visitors' Trophy presented by the Electrical Wholesalers' Federation. This was won by Mr. H. R. Ball of Birmingham with a score of 83−18=65. The prize for the best scratch score presented by Mr. Norman Hill was won by Mr. R. Edwards (English Electric Co., Ltd.), with a score of 79.

In the evening the annual dinner was held at the Grand Hotel, 350 attending. Sir Henry Self took the chair. The toast of the Electrical Industries National Golf Championship was proposed by Viscount Cobham, president of the M.C.C. The chairman of the Birmingham Area Committee, Mr. C. W. Kimbell, presented the chairman with a cheque for £350, the amount collected in his area for the Electrical Industries Benevolent Association. Sir Henry Self in replying announced that the total sum which was expected to be collected this year by means of this golf championship would amount to a record total of £3,400 and he thanked all those area secretaries and committees for the hard work done in organizing and collecting this large sum of money. He made special reference to the work of the national organizing secretary, Mr. Frank Farthing, for his share in organizing the golf meeting in Birmingham, and generally supervising the running of the whole championship during the year. Later Mr. W. S. Lewis, chairman of the Midlands Electricity Board, proposed in a witty speech the health of the E.I.B.A. The response was made by Sir Harold Bishop, president of the Association.

Careers for Graduates

AN invitation to graduate engineers and physicists to consider a career in the B.B.C. is contained in a booklet produced by the Corporation under the title " Engineers in the B.B.C." At the beginning of this year the Engineering Division comprised some 4,500 staff, of whom about 600 were fully qualified engineers and physicists, and about 2,300 were engineers not necessarily being fully qualified academically.

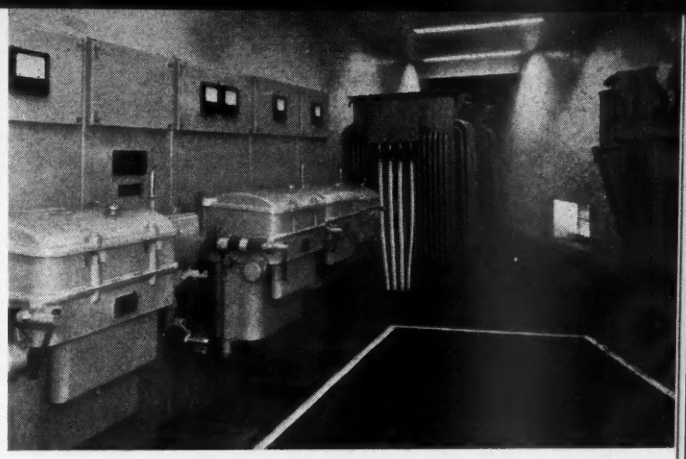
Each year the B.B.C. offers a number of graduate apprenticeships of two years' duration to engineers and physicists who obtain good honours degrees. It also has opportunities for men with a pass degree, and a special course is being prepared for them. The courses for honours graduates are designed not only to train the young engineer for the B.B.C. but to give him training that will satisfy the Institution of Electrical Engineers, and thus lead to professional status recognized throughout the profession. The course includes a training period at the Engineering Training Department, Evesham, a period of six months' practical works training in the workshops of a large radio manufacturing concern, and some months in two or more of the specialist departments of the B.B.C.

In addition, the B.B.C. recruits each year a number of graduates into the Operations and Maintenance Department, which employs about 2,000 engineers and technicians. Most engineers in this department work side by side with the producers and artists who make the programmes.

Copies of the booklet, which is being circulated to universities and technical colleges, can be obtained from the Engineering Establishment Officer, B.B.C., London, W.1.

Brewery Installation

NEW LEEDS MALTINGS OF JOSHUA TETLEY & SON, LTD.



Incoming supply substation

A NEW maltings in Chadwick Street, Leeds, was opened on 5th September by Joshua Tetley & Son, Ltd., an old established firm of brewers. The plant is housed in two buildings, one of which contains storage capacity for malt and barley, and the other the processing plant for conversion of barley to malt. This is done by germination in air conditioned drums, in place of the older traditional method of spreading barley on floors. The capacity of the plant is 26,000 quarters per year.

Barley is taken from storage and steeped for about 50 hours in water, whence it is pumped to the germinating drums, where it is germinated at controlled temperature and humidity for eight days. From the drums the green malt is conveyed pneumatically to the kilns, where it is dried and cured by a forced draught of hot air, finally being conveyed away pneumatically to screening and storage.

The object of building a maltings of this nature is to reduce the labour required as compared with the traditional type of floor maltings, and electrical power plays a major part in achieving this end, there being over a hundred motors from 1 to 60 h.p. in the plant.

The electrical installation was carried out by the brewery's own electricians under the direction of Mr. D. Holt, assistant engineer.

The h.v. supply from the Yorkshire Electricity Board is taken via two George Ellison isolators to two Metrovick 500 kVA 11 kV/230 V transformers which supply an Ellison switchboard consisting of two busbar coupled intake circuit-breakers, feeding four 300 A and one 600 A circuit-breakers. These serve the various sections of the maltings for refrigeration, germination, intake, dispatch and kilns.

The refrigerating plant provides chilled water for cooling the air intake to the germinating drums when the ambient temperature makes this necessary. Two ammonia compressors are driven by 40 h.p. motors, and these and the ancillary pumping equipment are controlled automatically within a range of 4 deg by Watford panels.

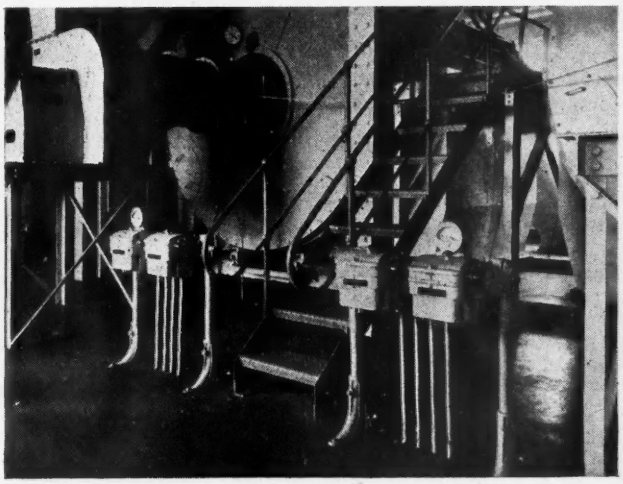
The germinating section consists of eight drums by Robert Boby, Ltd., provided with a geared drive to enable them to be rotated during the germinating period. An electrically driven fan circulates conditioning air and a pump provides water for washing, humidification and attemperation.

The air conditioning plant by Thermotank, Ltd., is controlled by Negretti & Zambra controllers and recording controllers, which operate air diaphragm motors. These control circulation of hot, chilled and room temperature water, and volume of circulating air. The starter gear in the germinating section and throughout the plant is by George Ellison, Ltd.

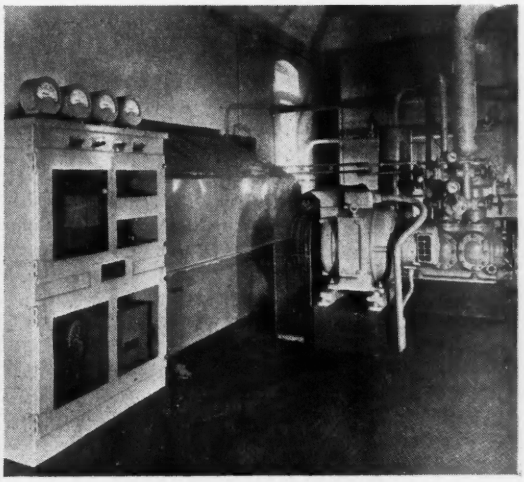
From the drums green malt is conveyed pneumatically to the drying kilns, the vacuum pump being driven by a 60 h.p. Metrovick motor. Hot air is passed through the "wedge wire" kiln floors at a temperature of about 160 deg F, the oil fired furnaces being supplied with regulated proportions of fresh and recirculated air, depending on the moisture content of the malt. Air volume is controlled by regulators acting on the 50 h.p. fan motor, and temperature is governed by recording controllers which operate "high-low" flame controls. "Radiovisor" flame failure equipment is provided.

From the kilns, cured malt is conveyed pneumatically to the silo building for screening and storage. The silo

Ellison starters on the barley sweating drums



Refrigeration compressors and controller



building is designed to handle both barley and malt, and incorporates a comprehensive system of band and worm conveyors and elevators, enabling barley and malt to be moved to any part of the building. As far as possible motor starters for these are mounted near by on panels so that the operator can start a whole circuit of conveyors from one point.

In addition to conveying, power is required to drive the barley sweating drums and their hot air fans. These are used to reduce the moisture content of incoming barley to an acceptable level for storage. The oil fired furnaces are controlled similarly to the kiln furnaces.

Comprehensive temperature control is provided for barley and malt in storage, barley containing up to 12 per cent moisture being susceptible to rises in temperature which are harmful to the germinating qualities of the grain. Thermocouples are fitted at three levels in each of the 48 silos, and wired to a central panel, with multiple switching.

In the wiring of both silo and germinating buildings extensive use was made of G.E.C. trunking, which showed a great saving of labour over screwed tubing. Pyrotenax cable was used for outside application and in some other instances. Reyrolle isolators and "Pullcap" fuses for power were employed. Lighting is mainly fluorescent.

Railway Signalling

TWO NEW SCHEMES FOR ELECTRIC SYSTEMS

GOOD progress is being made on the signalling works in connection with the electrification of the lines between Shenfield and Chelmsford and between Shenfield and Southend (Victoria). Colour light signalling was installed on both sections before the war, but as it is of the d.c. operated type, it is not suitable for use in conjunction with d.c. electric traction. Although the existing signals will be retained, all the controlling equipment will be replaced by new apparatus which will operate on a.c. only and will not be subject to interference by the traction current.

Power supplies at 650 V, 50 c/s, will be provided at the traction substations at Hylands, Ramsden Bellhouse and Prittlewell for operating the equipment, and as alternative supplies from the Central Electricity Authority are not available at Hylands and Ramsden Bellhouse, automatic diesel driven generating sets will be provided at these points to ensure the reliability of the signalling supply.

The total number of signals involved on the two sections is 93 and the number of track circuits 244. The Siemens & General Electric Railway Signal Co., Ltd., is carrying out the contract portion of the work to the requirements of the signal engineer, Eastern Region, and the total cost of the scheme is £270,000.

Another interesting signalling scheme, involving the resignalling of the Camden Town Junction on the Northern Line of the Underground, has just been carried out by London Transport. Camden Town is the most important junction on the London Transport tube lines, and over twelve hundred trains pass through it daily. The new installation, which allows completely automatic signalling and automatic routing of trains passing through it to all destinations, is the first of its kind.

Trains pass through the junction to and from two branches to the north (Edgware and Barnet) and two branches to the south (the Charing Cross and City sides of the Northern Line). The signals worked from the station are situated at Camden Town, Belsize Park, Chalk Farm, Kentish Town, Mornington Crescent and Euston. All routings which have hitherto been signalled from the Camden Town signal cabin will now be signalled automatically, together with the appropriate point movements, by means of train descriptions set by the signalmen at Edgware, East Finchley and Kennington cabins.

The new apparatus for the operation of the signalling consists of three "interlocking machines" each in separate relay rooms. The first two at Camden Town station actuate the signalling of the northbound and the southbound trains respectively. The third machine is at Mornington Crescent station and actuates the signalling in the Mornington Crescent area. The use of three separate interlocking machines has been deliberate in order to simplify installation and to make maintenance easier. Increased reliability is also achieved since in the event of any defect at one of the three relay rooms only a portion of the equipment would be affected.

Although the entire installation will operate automatically in the normal way, provision has also been made for push-button remote control operation of the interlocking machines from Camden Town when this may be necessary. A control room has been provided on the site of the former signal cabin. The interlocking machines can be operated from this point when required through a panel of 18 three-position push-buttons. A set of nine switches is provided to make the change-over from automatic to push-button control so that only the group of push-buttons required to be used need be switched in. The buttons and switches are set in a sloping panel type console similar in type to the installations made at Ealing Broadway in 1952 and at Wembley Park in 1954. An illuminated track diagram and train description diagrams of the normal type are supplied.

The installation has been carried out by Mr. R. Dell, signal engineer, under the direction of Mr. C. E. Dunton, the chief civil engineer. The installation work has been carried out by London Transport's own signals staff over a period of nine months without interruption to traffic.

New control room on the site of the former Camden Town cabin

Engineering in Europe

EXTRACTS FROM FOREIGN TECHNICAL JOURNALS

THE d.c. transmission described is an experimental installation with the following main parameters: operating voltage 200 kV, line current 150 A, power transmitted 30 MW. The rectifier and invertor stations are connected by single-core 200 kV d.c. cables of 112 km length. The substations have bridge-connected rectifier and invertor units (a single bridge circuit in each substation).

Each bridge arm comprises three rectifier units. The maximum current of each unit is 150 A, the inverse voltage 120 kV. The line started experimental operation in December, 1950. About the middle of 1951 the transmission was taken up to the planned operating voltage of 200 kV when a number of faults occurred, viz. arcbacks of rectifier and forward breakdowns of invertor valves, overvoltages causing flash-overs on valves and other equipment, and considerable radio interference. There were also ignition troubles, either by failure of the main arc to ignite or by extinction of the pilot arc, causing outages of the transmission.

The thorough investigation of these phenomena and their causes resulted in necessary improvements and reconstructions so that the operation could be rendered more reliable. Alternative solutions of the problem of h.v. transmission, viz. systems with earth as return path, with an overhead line, series-parallel connection of the convertor units forming a group, and with only one unit in a bridge arm, were also studied. The results of all these investigations form a body of valuable information for the layout and design of d.c. transmission systems and their equipment.—" H.V. D.C. Transmission," V. P. Pimenov and M. R. Sonin, *Elektrichestvo,* No. 7, pp. 93-99, 1955, in Russian.

Impulse Testing of Surge Diverters

The designers had to solve the problem of installing an impulse voltage generator in a comparatively restricted space in existing premises using available cheap capacitors and still building up a versatile installation within a short time. The capacitor bank comprises 30 capacitors of 3 μF/60 kV rating, connected in 5 stages of 6 capacitors each, which in the well-known Marx circuit supply an impulse voltage of 1·1 MV at an effective capacitance of 0·1 μF. The energy stored is 60,000 joules. The capacitor bank has been charged so far by argon-tungsten rectifier valves which will in future be replaced by dry h.v. rectifiers. The charging resistances consist of asbestos cord since this is more suitable for the considerable charging energies than the usual water resistances which, however, are still used when smaller impulse voltages are required (220 or 110 kV) because in this case their adjustment is more convenient. The reproducibility of the impulse voltages is assured by the insertion of a releasing and amplifying relay into the charging circuit, the precision obtainable being 0·5 per cent. By this arrangement pulse trains of a repetition period of 3 seconds may be obtained. The capacitor bank may also produce current, instead of voltage, pulses up to a gradient 5 kA/μ sec and an amplitude of 150 kA, thus equal to the highest lightning currents actually observed (and of very rare occurrence). The impulse generator is supplemented by other special control equipment to be used instead of, or in combination with, the releasing relay, and by a travelling wave line, utilizing the phenomenon of the amplifying reflection at the open end of such a line for a further increase of the available impulse voltage to 1.8 MV. The recording cold-cathode double-beam oscillograph corresponds to types used elsewhere for impulse phenomena.—" The New Impulse Testing Installation for Surge Diverters," W. Buch, *Siemens Z.*, Vol. 29, No. 7, pp. 253-259, June, 1955, in German.

Gas Occlusions in Cables

For 30 years now the development of h.v. cables has been characterized by a tendency to raise the ionization gradient and the threshold of the destructive action of ionization, with the result that higher pressures and thinner layers of insulation are used in modern cables. However, the ionization phenomena in themselves cannot be considered as completely known or explained, although some important characteristics of these processes are fairly well represented by approximative relations, e.g. Paschen's law relating ionization gradient and pressure. The authors set themselves the task of investigating the relation between the proven empirical laws of the ionization processes and the physical theories of ionization processes, or what is called ionization mechanisms, advanced so far. These theories introduce a number of working hypotheses, for example, partial or successive discharge mechanisms, recombination mechanisms, etc., the interaction or alternation between which represents more or less the crux of the problem. It is found that the experimental investigations carried out seem to admit an interpretation based on the existing theories, that is, under certain conditions, particularly when the insulant contains free gas. One could not agree more with the authors' final remark that the full solution of the problem of gas ionization has to wait for the solution of the problem of the intrinsic dielectric strength. —" Investigation of the Ionization Phenomena in Gas Occlusions in H.V. Cables," J. Oudin, H. Thevenon and I. Eyraud, *R.G.E.*, Vol. 64, No. 6, pp. 267-272, June, 1955, in French.

Recovery Voltages

There are different possible approaches to the important problem of recovery and restriking voltage, and symmetrical component representation enables the most important special cases to be systematically analysed without the necessity of going into details of the power system considered. The author begins with the recovery voltage in the case of a three-phase short-circuit (since this case may be solved without knowing the method of neutral earthing used), and then deals with two-pole and single-pole short-circuits to earth. The restriking voltage is then calculated for simple systems, again for three-pole short-circuits without earth fault, and with earth fault in a solidly earthed system, two-phase faults without and with earth fault and single-phase short-circuits to earth. A simplifying representation is then introduced for a system comprising a power station of known power on short-circuit

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review.*

and natural frequency, which is represented by a circuit with lumped constants, and a line with distributed constants. A graphical method of determining the restriking voltage and the "equivalent frequency" for a fixed and for variable fault points and various powers on short-circuit is then demonstrated with reference to a numerical example. The case of complicated and extended systems for which the recovery voltage cannot be calculated is treated by discussing the method of determining it by means of network analysers and analogue computers, with reference to oscillograms showing the results of such investigations, differing according to nature and location of the fault.—"The Recovery Voltage on Clearing Short-Circuits." H. Dorsch and M. Erche, *Siemens Z.*, Vol. 29, No. 7, pp. 260-268, June, 1955, in German.

Differential Line Protection

A new type of h.f. differential-phase protection is described for which a high sensitivity to all forms of short circuits is claimed. On the other hand, it is insensitive to overloads and power swings and remains serviceable in non-full-phase operation. Its mode of operation is the comparison of the phases of positive and negative sequence currents at the ends of the line by h.f. currents. The components of the installation and their interaction are briefly described, particularly the starting elements, the control by the h.f. transmitter and the method of comparing the current phases. The general principles of design and application of similar protection systems are also discussed. A special case considered is the use of the system on lines equipped for single-phase rapid reclosing. It is found that in two-phase operation the protection will reliably respond to inter-phase short circuits, but in the case of single-phase short circuits in the protected zone it may occasionally be blocked. The presence of a spur line in the transmission system does not interfere with the correct operation of the protection. The conditions to be satisfied to assure selectivity of the response at external short circuits and reliable operation when faults occur in the protected zone are also discussed. —"H.F. Differential-Phase Protection of 110-220 kV Lines," E. D. Sapir, *Elektrichestvo*, No. 6, pp. 48-53, 1955, in Russian.

Thermal Overload Trips

The problem considered is the impossibility of a complete adjustment of the heating time constant of the comparatively simple bimetal elements controlling overload releases, to the heating time constants of complicated constructions such as electric motors. This is clearly demonstrated by the fact that the temperature rise of the bimetal elements can be accurately enough represented by an analytical expression involving a single or at most two exponential functions, whereas the heating process of an electrical machine is so complex that it cannot be represented theoretically at all. It must therefore be determined experimentally and for this reason the matching of releases to motors is not only always affected by systematical errors, viz. those of the approximate character of the theory and the experimental errors, but also by the arbitrariness in correlating theoretical and experimental facts. The author not only demonstrates a fairly satisfactory and not too involved correlation method, but also surveys critically the existing Swiss, German, U.S.A., Canadian and British regulations in this field by comparing their stipulations with empirical curves obtained in various types of motors and releases. Particularly the Swiss regulations are found to be over-cautious, forcing the designers to make the releases too "fast," this leading to a bad utilization of the motors which are cut out at temperatures not endangering the quality and service life of the insulation.—"A Critical Consideration of the Requirements for Thermal Overload Releases," J. Kirchdorfer, *A.S.E. Bull.*, Vol. 46, No. 13, pp. 604-613, 25th June, 1955, in German.

High Voltage D.C. Transmission

Although the d.c. transmission described does not represent the first case of a d.c. transmission in practical operation, it is definitely the first example of an installation of the type most likely to be adopted for other large-scale d.c. transmissions. The report presented by the author on the first year of operation is therefore of great interest, even though the plant operated represented only the first stage of the planned development and the operation with a transmitted power of only 10 MW was actually intended as a testing period. The fact that the power is transmitted through 100 km of cable, 80 km of which are submarine cable, is particularly interesting in connection with the discussions on the interconnection of the British and French power grids through the English Channel and the consideration of a d.c. transmission for this purpose. Due stress is laid on considering the relative economic merits of d.c. and a.c. transmission. The author also considers other variants of rectifier and inverter circuits than those actually chosen, and their characteristic modes of operation, all the relevant details of the rectifier and inverter, control, compensating and protective equipment and the normal frequency and current regulation by radio-link as well as the emergency control when the radio-link is not in service. The article is profusely illustrated.—"H.V.-D.C. Transmission, Particularly the Gotland Transmission," B. Funke, *Ingenioren*, Vol. 64, No. 23, pp. 482-491, 4th June, 1955, in Swedish.

Transatlantic Telephone Cable

THE final splice in the first telephone cable ever to be laid across the Atlantic was made off Oban on 26th September, and the testing of the cable from its terminals near Oban and at Clarenville, Newfoundland, is now proceeding. This cable is the first of two which will form the trans-ocean link in the transatlantic telephone cable system due to be completed towards the end of next year. It is about 2,000 nautical miles long and includes 51 repeaters.

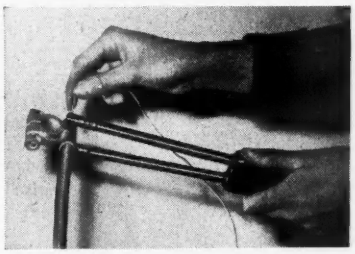
The task of laying the world's longest repeatered submarine telephone cable, at depths never before attempted, has been completed by H.M.T.S. *Monarch* ahead of schedule. In the early summer she laid out from Clarenville, Newfoundland, 200 miles with five repeaters and buoyed the seaward end. On 8th August, after loading more cable and repeaters at Erith, Kent, the *Monarch* picked up the buoyed end and laid 1,500 nautical miles of cable with 29 repeaters, in one length, across the deepest part of the Atlantic. The weather was kind in the early stages but the difficult operation of buoying off the end of this cable on the Rockall Bank was carried out in a fierce gale. It was successfully completed on 18th August.

After again loading with cable and repeaters *Monarch* left Erith on 12th September to pick up the buoyed end on the Rockall Bank and lay the last 500 nautical miles to Oban. Meanwhile, the *Iris*, a smaller cable ship, had laid a short shore end out from the terminal station near Oban, and the final splicing of the 2,000 nautical miles of cable, stretching back to Newfoundland, with this shore end took place on board the *Monarch* on 26th September. The splicing operation took 8 hours and when completed and the joint had been tested (X-rays were used), the cable was lowered overboard and for the first time Newfoundland and Great Britain were linked by a submarine telephone cable. Not until the second cable is laid in 1956 will two-way conversations be possible, since each cable carries speech in one direction only.

NEW ELECTRICAL EQUIPMENT

Twin Electrode Soldering Iron

A tong action twin-electrode low voltage soldering tool has been introduced by AIRCRAFT SERVICES & EXPORT, LTD., 15, Buckingham Palace Gardens, London, S.W.1. Known as the "Venum," the tongs act as current leads and heat the work directly instead of by heat transfer. For soldering, the parts are held in the tongs and a button switch on the handle is pressed.



"Venum" direct heating solder tool in use

Stems are detachable and interchangeable, enabling different types of work to be catered for, and the carbon electrodes which come in contact with the work are easily renewable. It is claimed that no tinning or cleaning of the work is required. Operation is from a 6 V battery or transformer and the tool can be used on solid material from $\frac{1}{64}$in to $\frac{1}{2}$in diameter.

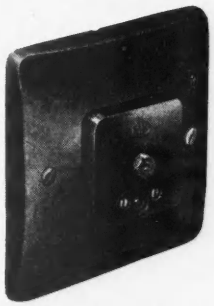
Washroom Dryer

CRYPTO, LTD., North Circular Road, London, N.W.10, have introduced a new electric hand and face dryer. The machine is simple in design, finished in vitreous enamel and operated by a foot pedal. When this is depressed a stream of hot air is blown over the heating element and out through two nozzles. Considered as a substitute for linen or paper towels it is claimed that running costs are so low that the machine will soon pay for itself. The dryer stands 43in high and averages 25 sec to dry a pair of hands and 45 sec for hands and face.

Crypto washroom dryer

Fuse Connector Box

M.K. ELECTRIC, LTD., Wakefield Street, London, N.18, has produced a new accessory designed to enable clocks and similar fixed appliances to be looped from a ring circuit. Generous and well-positioned terminals accommodate 7/·029in cable, and there is provision for earthing. A 1 A cartridge fuse link to B.S. 646: 1944 type A is housed in the removable carrier, which is fitted with a flex-grip. The fixing centres are $2\frac{3}{8}$in apart thus enabling the connector box to be mounted in standard boxes to B.S. 1363, and if required, the extremely shallow back projection will fit into a plaster-depth box to avoid the need for chasing brickwork. The catalogue number of this accessory is 999.

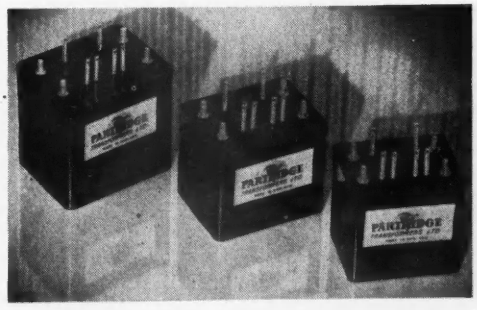


M.K. fused connector box

Miniature Transformers

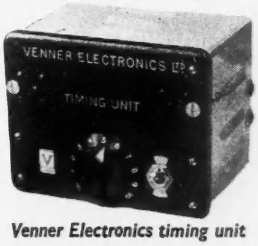
Two new miniature types of transformer have recently been added to the products of PARTRIDGE TRANSFORMERS, LTD., Roebuck Road, Tolworth, Surrey. The range is available in five sizes and can be either hermetically sealed with oil or compound filling; or embodied in synthetic resin. They are particularly suitable for audio frequency and high frequency power applications where a miniature product of robust construction is required to withstand tropical conditions. Either upright or inverted mounting can be arranged and the core material can be nickel iron or of the grain oriented silicon type.

Partridge resin potted transformers



Timing Unit

The features of a new timer introduced by VENNER ELECTRONICS, LTD., Kingston By-Pass, New Malden, Surrey, include small size, low price and the fact that it makes unit construction of timing equipment possible. Any time sequence involving individual times of five minutes or less can be arranged with the timers without making any wiring alterations to the instrument itself.



Venner Electronics timing unit

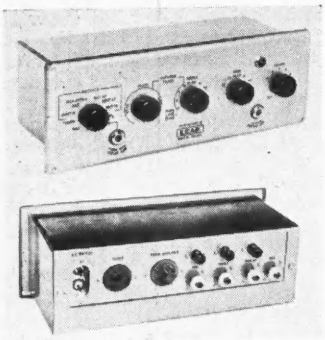
A contact starts the timing period, changing over a pair of single pole contacts. At the end of the period the contacts change back and an output lead is momentarily short circuited. This lead can be connected to the input of another timer and this will therefore start the second timing period. This process can be repeated as many times as required and if necessary the pulse from the last unit may be passed back to the first so that the chain will form a cyclic timer. A push-button can be provided so that all the units can be returned to "safe" if desired.

Typical units cover a range of 0·1 second to 10 seconds, or 0·1 second to 60 seconds, and the time over which the instrument is most likely to be operated is set mid-scale at the works.

Pre-Amplifier for High Fidelity Reproduction

A new pre-amplifier, the "Varislope" Mark II, to give flexible and accurate control over the quality of sound reproduction from records, broadcasts, or tape recordings has been designed by H. J. LEAK & CO., LTD., Brunel Road, London, W.3. Certain types of distortion are inherent in broadcasting and recording and better tone quality can be obtained if a pre-amplifier has facilities to suppress these distortions.

The most objectionable types of distortions inherent in records, broad-



Front and back views of the "Varislope" Mark II pre-amplifier

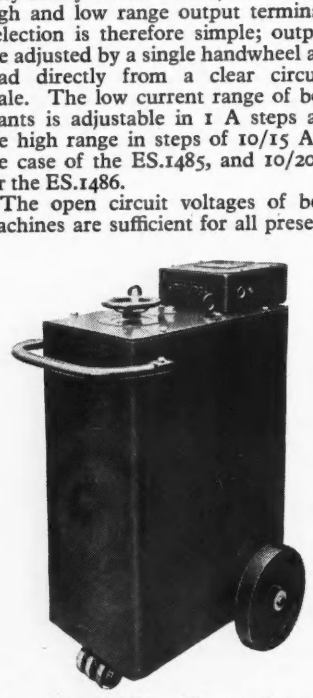
casts, and tape recordings occur at treble frequencies, and one of the most important features of the "Varislope" Mark II pre-amplifier is the accuracy with which such distortions can be reduced. Facilities are given on the pre-amplifier to enable the listener to connect very simply a microphone, a tape recorder, a record-player, and a radio receiver, and the "Varislope" controls enable him to extract the highest quality obtainable from these devices.

Welding Transformers

Two new oil-cooled transformers suitable for medium and heavy fabrication work have been introduced by PHILIPS ELECTRICAL, LTD., Century House, Shaftesbury Avenue, London, W.C.2. They are constructed in accordance with B.S.S. 638 and are known as type 1485 and 1486. In both cases, welding current is selected by means of a positive-action, heavy-duty rotary switch in conjunction with high and low range output terminals. Selection is therefore simple; outputs are adjusted by a single handwheel and read directly from a clear circular scale. The low current range of both plants is adjustable in 1 A steps and the high range in steps of 10/15 A in the case of the ES.1485, and 10/20 A for the ES.1486.

The open circuit voltages of both machines are sufficient for all present-day electrodes and for the Philips stud welding process. The ES.1485 has a maximum intermittent welding current of 300 A and a maximum continuous current rating of 250 A. The corresponding figures for the ES.1486 are 400 A and 350 A.

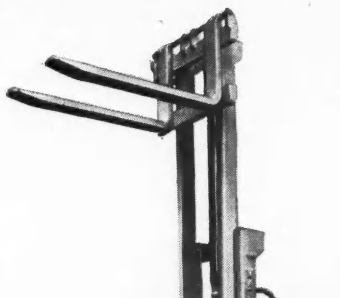
All components are housed in a heavy gauge mild steel tank, totally enclosed, and oil immersed. An oil filler cap and dipstick are provided.



Philips type ES.1486 welding transformer

Battery Powered Stacker

MATLING, LTD., of 28, Caxton Street, London, S.W.1, have introduced additional models to their range of battery powered standard stackers. These new stackers have a lift height of 6ft or 7ft 6in without any increase in the overall width of the support legs. Capacities of 1,000 lb or 2,000 lb at 20in load centres are available. These machines can be supplied with support legs only 18in or 20½in wide, thereby allowing them to be used with the narrowest stillages and pallets.



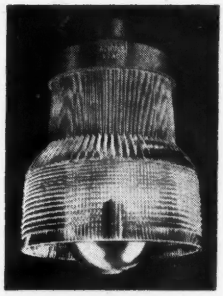
Matling battery operated stacker 7ft 6in lift

A new "glide control" feature incorporates a pre-selector type speed selection, coupled with automatic clutch damping, and provides a smooth drive take up and consequent operator safety with elevated loads. The simplicity of the design as a mechanically propelled vehicle as well as the accessibility of its components ensures easy and rapid maintenance.

Street Lighting Refractor

The "Lumifractor" is a new dome type refractor for narrow Group B roads by HOLOPHANE, LTD., Elverton Street, London, S.W.1. This development is a departure from traditional lantern design and a prototype was exhibited at the recent A.P.L.E. Conference.

It requires the minimum of metalwork and embodies a glass canopy integral with the refractor, with quick action spring attachment to a weather-shed aluminium head casting carrying the lampholder. Prisms for light control are moulded on both inner and outer surfaces providing a two-way non-axial light distribution 170 deg in plan, and with a vertical beam angle of 78 deg.



Holophane "Lumifractor"

The refractor reference is 2/4117 and it is suitable for tungsten filament or blended lamps up to 200 W, or up to 125 W for mercury discharge or fluorescent lamps. It is also suitable for 80 W MB/U lamps, 80 W MBF/U, 160 W MBT/U and 200 W MBT/V lamps.

CATALOGUES AND LISTS

AGRICULTURAL EQUIPMENT. — Three booklets dealing with agricultural, horticultural and dairy equipment.—**General Electric Co., Ltd.,** Magnet House, Kingsway, London, W.C.2.

BLANKETS AND PADS.—15-page illustrated catalogue and price list dealing with the company's range of appliances for home and medical use.—**Thermega, Ltd.,** 51-53, Victoria Street, London, S.W.1.

CABLE ACCESSORIES. — Descriptive catalogue (EN.111) of high voltage jointing accessories for solid type cables.—**Enfield Cables, Ltd.,** Victoria House, Southampton Row, London, W.C.1.

HEATING.—Illustrated priced leaflet dealing with the company's portable oil-filled radiators.—**Hurseal, Ltd.,** 229, Regent Street, London, W.1.

Three priced folders and leaflets dealing with Dimplex oil-filled electric radiators and a folder giving advice on the uses of the company's products.—**Dimplex, Ltd.,** Totton, Southampton.

Illustrated descriptive folder on the "Yelsen" electric radiators.—**Yelsen, Ltd.,** Ruxley Corner, Sidcup, Kent.

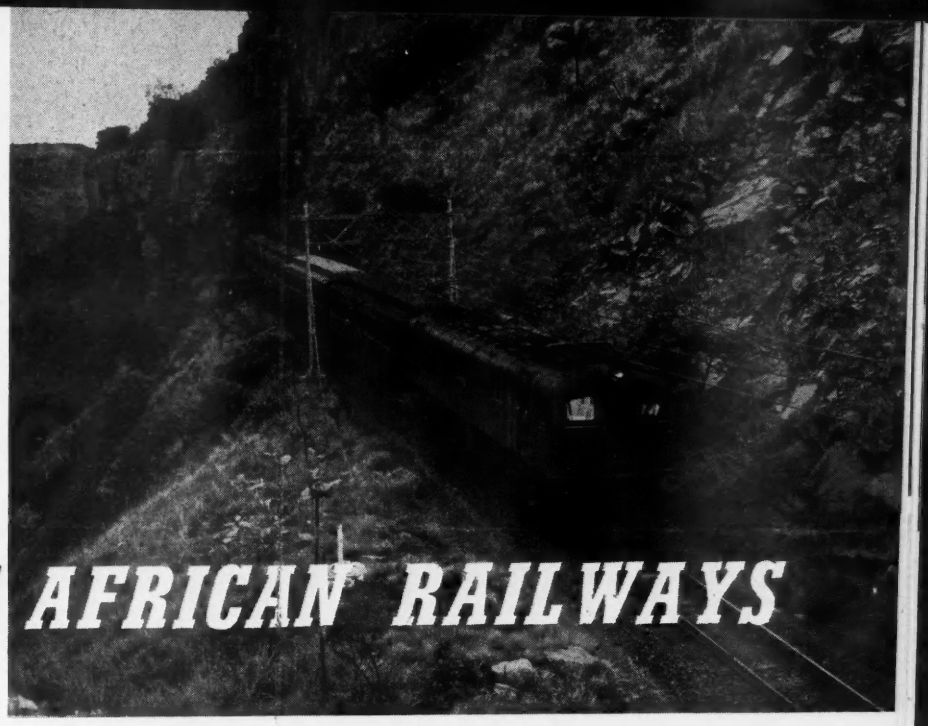
HEATING ELEMENTS. — Illustrated priced catalogue of the companys' range of replacement elements and spirals.—**Metway Electrical Industries, Ltd.,** Metway Works, Kemp Town, Brighton, 7.

INSULATORS. — Illustrated 36-page booklet on aspects of the production and testing of porcelain insulators.—**Doulton & Co., Ltd.,** Doulton House, Albert Embankment, London, S.E.1.

LAMPS.—28-page descriptive catalogue of the company's range of electric lamps, together with separate price lists.—**Philips Electrical, Ltd.,** Century House, Shaftesbury Avenue, London, W.C.2.

SWITCHGEAR. — 23-page descriptive catalogue (LS30), on the company's heavy industrial distribution switchgear.—**Lancashire Dynamo Switchgear, Ltd.,** Trafford Park, Manchester.

WIRING ACCESSORIES. — Catalogue and price list dealing with the company's range of switches.—**Rolls Switches, Ltd.,** 154-156, Blackfriars Road, London, S.E.1.



Metropolitan-Vickers "3E" class locomotive hauling the Durban–Johannesburg mail train on the Natal system

Progress of Electrification

SOUTH AFRICAN RAILWAYS

CHEAP and abundant supplies of coal in South Africa have made it unnecessary to contemplate a wholesale change-over from steam traction on the railways, but electric traction has asserted itself under certain conditions, and the extent of electrification is one of the most interesting transport developments in South Africa. The increase of population in certain urban regions, and the difficult country through which frequent and heavy loads have to be hauled in some areas, have combined to give electric traction certain specific advantages over steam traction. Working results have shown conclusively that there are many advantages in electric traction where, for instance, suburban and inter-urban services have to be catered for by fast and frequent train services.

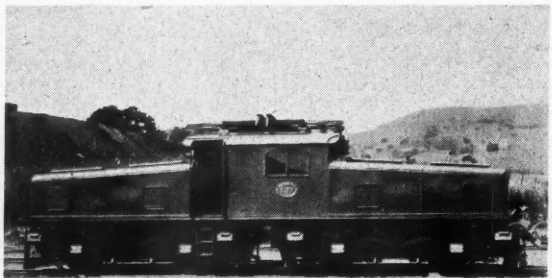
At 31st March, 1954, the South African Railways had 1,658 track-miles equipped for electric traction, mainly at 3,000 V d.c., which means that since 1930, when only 364 miles had overhead track equipment, 1,294 miles have been added. When the electrification schemes now under construction are completed the position will be that out of 13,394 route-miles (excluding 793 miles of narrow gauge) over which the railways are operating, 941 miles will be electrified, and that of 16,642 track-miles, 1,829 will be electrified. The South African Railways now have in service 248 electric locomotives and 289 motor coaches.

Electric locomotives have run a gross total of 297 million miles and electric motor coaches 226·8 million miles since the introduction of electric traction in South Africa in 1926, the highest individual mileage of any one electric locomotive being 2,088,729 and that of any one motor coach 1,388,562 miles. The number of ton-miles under electric traction throughout South Africa increased from 8,237 million during 1952-53 to 8,688 million in the year ending 31st March, 1954, while the number of suburban passengers carried in the Cape Town and Witwatersrand electrified areas increased from 197·2 million to 202·9 million.

Historical

Electric rail traction was suggested for the first time in South Africa in 1903, shortly after the South African War, and the possibility of electrifying the Randfontein-Springs section was examined. Very little was known at the time about the economics of this form of traction and the project was not pursued. In 1912 the question was again raised, but before any positive action could be taken, the first world war broke out. In spite of this some progress had been made by 1919. The sections selected for electrification included Cape Town-Touws River (completed in 1954), Cape Town-Simonstown, parts of the Natal main line between Durban and Johannesburg and certain sections of the Witwatersrand railway network. By 1921 the preliminaries had been completed and plans were made to start construction work. The project was halted again, however, by the then prevailing world-wide depression. The electrification of the Cape Town-Simonstown section

A goods train hauled by three Metropolitan-Vickers "$1E_1$" class locomotives on the main line between Johannesburg and Durban



"ES" class 1,200 h.p. electric shunting locomotive

was consequently deferred but the position of the Natal main line had become so critical, due to the difficulty of coping with ever-increasing traffic, that it was decided to start with the electrification of the section between Pietermaritzburg and Glencoe junction at an estimated cost of £4 million.

NATAL

In the Province of Natal the steep gradients which have to be negotiated give electric traction certain definite advantages. Many heavy freight and passenger trains have to be brought from Durban over several ranges of mountains to the interior, and particularly to Natal's main distribution area, the Witwatersrand. Johannesburg is 494 miles from Durban and fast running times have to be maintained to meet public demands.

Electric traction on this system is used exclusively for main-line trains, which are operated over a route-mileage of 426 (735 single-track miles). More than 12 million train-miles are run annually in Natal by electric traction, the ton-mileage figure being 7,000 million.

As a result of the severe curvature of the Natal system, the locomotives designed specifically for operation on these lines are four-axle types. Numbers were built between 1925 and 1937, all being generally similar (classes 1E and 2E). The two two-axle bogies are articulated, the buffers and drawgear being mounted on the head-stocks so that the tractive effort is transmitted through the bogie frames (Bo+Bo wheel arrangement). Electrical equipment was supplied by the Metropolitan-Vickers Electrical Co., Ltd., who also built many of the complete locomotives. The four axle-hung traction motors are rated at 300 h.p. each (one hour) and operate at 1,500 V, being connected all in series or in two series pairs in parallel across the 3,000 V line. With one weak-field notch in each grouping, four economical running speeds are available. The fields can be separately excited for regenerative braking. Maximum tractive effort at the one-hour rating is 21,200 lb, and the maximum service speed 45 m.p.h. The locomotives are designed for multiple-unit operation, two or three being coupled together and controlled by the leading driver.

Sixty more four-axle locomotives intended for the Natal system were ordered from the English Electric Co., Ltd., in 1952, deliveries of which began this year. They have a one-hour rating of 2,000 h.p. and weigh 83 tons. The control system provides two groupings of the four traction motors, with weak-field steps in each, and regenerative braking.

The first substations for the Natal system had motor-generator equipment, which simplified the problem of accepting regenerated power. Substations on later extensions had steel tank, water-cooled, pumped mercury arc rectifiers. In most of them two units are installed, one acting as an inverter for returning power to the supply system.

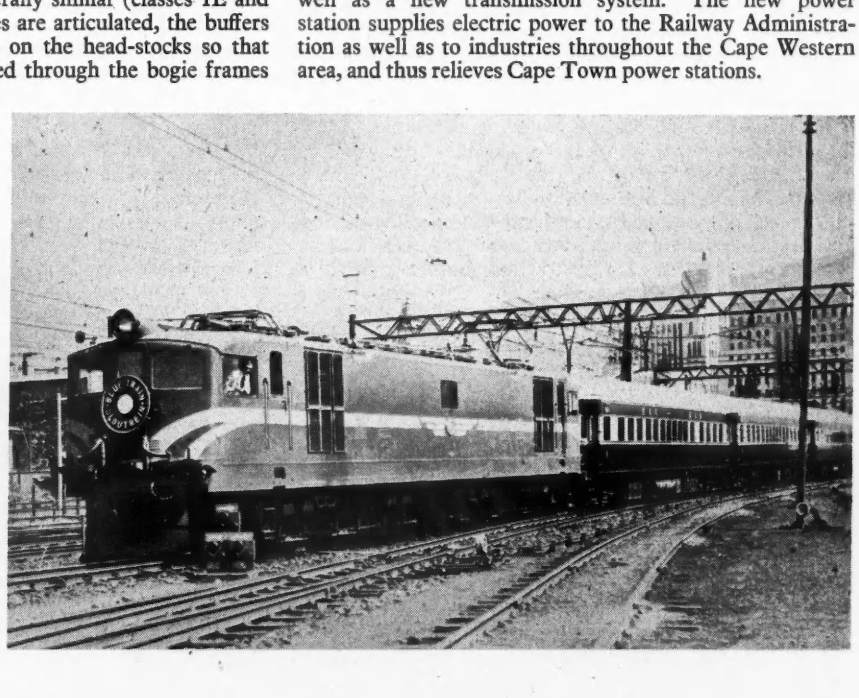
CAPE PROVINCE

In the Cape Province a large-scale electrification scheme has been carried out. The electrification of the Cape Town-Johannesburg main line through the mountains and vineyards of the Western Province from Bellville to Touws River, a distance of 148 miles, was completed on 14th May, 1954. The estimated cost of this 3,000 V d.c. electrification, including the Stellenbosch loop line, near Cape Town, and the provision of substations, was £2·7 million. Work was started in October, 1949.

The line winds its way through the precipitous passes of the Hex River Mountains, the most formidable barrier between the Cape coastal belt and the interior. The expansion of agriculture and industry in the Western Province plus the increasingly heavy traffic between the Transvaal and the Cape were the main determining factors for the electrification of this section.

New Power Station

As a direct result of the Bellville-Touws River electrification a £3·6 million power station was built at Worcester, as well as a new transmission system. The new power station supplies electric power to the Railway Administration as well as to industries throughout the Cape Western area, and thus relieves Cape Town power stations.



North British–G.E.C. "4E" class 1-Co + Co-1 locomotive, South African Railways, leaving Cape Town with the Blue Train

Another consequence of the Bellville-Touws River electrification was the decision to convert the Cape Town 1,500 V d.c. suburban system to 3,000 V, and completion of this work on the 12 miles between Cape Town and Bellville at the end of 1954 enabled electric locomotives to work full main-line loads throughout between Cape Town and Touws River. The new mercury arc rectifier substations provided for this scheme have been arranged to supply 1,500 V at first, but to be readily adaptable for the change-over to 3,000 V as new electric suburban rolling stock becomes available. Traction equipments for the Cape Town suburban 3,000 V multiple-unit trains have been supplied by the Metropolitan-Vickers Electrical Co., Ltd.

Operating experience with electric locomotives using regenerative braking between Bellville and Touws River has shown that in general regenerated power is absorbed by direct interchange between trains, but resistance loading equipment is provided at a number of substations, and is brought into circuit by thyratron-controlled ignitrons if the line voltage rise exceeds a certain value.

The main-line locomotives for the Cape Town-Touws River electrification were built by the North British Locomotive Co., Ltd., with electrical equipment by the General Electric Co., Ltd. Forty were supplied, of which 30 have been allotted to the Cape system and 10 to Natal. They comprise class 4E, and are carried on two articulated motor bogies each with three driving axles and a leading pony axle (1-Co+Co-1 wheel arrangement). With their one-hour rating of 3,030 h.p., they are the most powerful design that has been produced for a 3ft 6in gauge railway. Their tractive effort (at 25 per cent adhesion) is 72,000 lb.

Three motor groupings with three weak-field steps in each give twelve economical running speeds. Regenerative braking is available in all groupings, one of the specification requirements being that a locomotive should be able to hold a 610-ton passenger train at speeds between 40 and 55 m.p.h. on a down gradient of 1 in 66 by the use of regeneration alone, and a 1,070-ton goods train on the same gradient at speeds between 25 and 40 m.p.h. The locomotives work singly except between De Doorns and Matroosberg, where there are some 15 miles at 1 in 40 to 50. On this section trains are hauled by two locomotives in multiple-unit under the control of one crew.

Since traffic on the Touws River line was taken over by these electric locomotives the running times of goods trains have been reduced by about 90 minutes in each direction, while those of passenger trains are about 45 minutes shorter than previously. Goods loads to De Doorns have been increased from 820 tons to 1,000 tons, in comparison with steam traction, and from 430 tons to 680 tons from De Doorns across the Hex River Mountains.

Running sheds and a modern electric locomotive depot have been built at Salt River at a total cost of £935,000 for servicing the electric locomotives and motor coaches.

TRANSVAAL

On the Witwatersrand, the main axis of the Union's gold-mining industry, inter-urban services between the various Reef towns were the first to be electrified. Pretoria, the administrative capital, was later included in the network. A total of 207 route-miles is now electrically operated in the Transvaal while ten route-miles are at present under construction.

The annual train mileage in the Reef area is nearly six million while passenger journeys increased from 25·6 million in 1936 to 117·1 million in the year ended 31st March, 1954.

In connection with the post-war extension of Reef electric train services, the Metropolitan-Vickers Electrical Co., Ltd., supplied 54 traction equipments for multiple-unit trains and 28 2,700 h.p. electric locomotives (class 3E). The latter is a six-axle design with articulated bogies (Co+Co) and capable of exerting a tractive effort of 34,500 lb at the one-hour rating. These locomotives have also operated main-line trains on the Natal system, and on the Reef system work long-distance passenger services between Pretoria, Johannesburg, and Welverdiend, 59 miles from Johannesburg on the main line to Cape Town. Since the war, also, the Metropolitan-Vickers Electrical Co. has supplied ten traction equipments for 1,200 h.p. Bo+Bo locomotives used mainly for shunting, and recently received a contract for traction equipments for 349 electric coaches.

1,500 V d.c. multiple-unit suburban train on the Cape Town–Simonstown line, now being converted to 3,000 V

All trains in the Reef area can now be worked electrically and the intention is to work all trains within the industrial area of the Witwatersrand, Pretoria and Vereeniging with electric traction.

New motor coaches which are 75 per cent more powerful than the old stock are now in service, permitting accelerated schedules and providing for denser traffic conditions. They show a substantial saving in specific power consumption, and incorporate improvements for passenger comfort, such as fluorescent lighting.

A high rate of acceleration is achieved in the latest motor coach stock. On the Cape system the conversion of power supplies from 1,500 to 3,000 V is being accompanied by the installation of electro-pneumatic braking in suburban passenger coaches, so that the running times of stopping trains will be further improved.

Oil Switches

WITH the publication of B.S. 2631, a further part of B.S. 116: 1937 which was mainly superseded by B.S. 116: 1952, "Oil Circuit-breakers for A.C. Systems," has been revised. The standard gives the requirements for manually operated three-pole, 400 A oil switches, which may be fitted with integral earthing devices, for voltages of 3·3, 6·6, 11, 22 and 33 kV.

The service conditions for which the switches are suitable are given and tests specified include mechanical endurance, temperature-rise, impulse-voltage withstand (22 and 33 kV switches only), making-capacity, breaking-current, and short-time current. Detailed information regarding selection, testing, measurements during the tests, and maintenance is given in appendices. Copies of this British Standard are obtainable from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1, price 6s.

GENERATION AND DEVELOPMENT

Freedom of Choice in Glasgow

Glasgow Corporation is to install both gas and electricity in future housing schemes and tenants will have the opportunity to select either medium for cooking and wash boiler purposes. Hitherto the Corporation has limited installations to gas, which has meant a virtual monopoly for the gas industry in new Corporation housing schemes. The change, approved by the Housing Committee on 21st September, follows representations by the South of Scotland Electricity Board and the Consultative Council, and has also been influenced by requests from residents for the removal of gas services and their replacement by electricity. The South of Scotland Board has reduced the installation charge to the Corporation from £15 to £5 per house and will maintain cookers and wash boilers at a cost per house of 10s per year.

The Corporation will install in each house an electrical circuit and a cooker control unit in addition to the piping for gas appliances. It then becomes a matter for the individual tenant to decide whether the appliances shall be gas or electrical. This change of policy will mark a new period of intensive selling in the city, with gas and electrical interests competing to secure a larger proportion of the new installations.

Tenants and Services

Hebburn (Co. Durham) Works Committee has rejected a suggestion by the Northern Gas Board that prospective tenants of new houses should be asked whether they preferred gas or electricity in their dwellings. The Board pointed out that gas pipes were laid to all new houses, but many tenants were using only electricity. If the wishes of the tenants were known beforehand, it would be possible to reduce expenditure on gas pipes.

Irish Board's Loan

Mr. R. F. Browne, chairman of the Irish Electricity Supply Board, announced in Dublin last week that the Board had decided to seek a public Government-guaranteed loan of £10 million at par, 1966-75, with 5 per cent interest. Up to 31st March last the Board had been financed from the Central Exchequer and given advances of £55½ million. It had always paid in full the annual interest on State advances and repaid borrowings by sinking fund arrangements; it had now a depreciation reserve of £13 million, a contingency reserve of £1 million and a full equalization reserve of £500,000.

Money was required for capital development, which included the erection of eleven generating stations. So far, output had doubled every five years.

The showroom of Seeboard in the Plummer Roddis Departmental Store, Brighton

Appliances for Council Houses

On Monday last the Plymouth Corporation decided that electric immersion heaters should be installed in all its new houses, a rent of 2d a week being charged. It is believed that 1,000 will be installed in the first year, including 780 on the new Southway estate which will ultimately consist of 2,500 houses. The Corporation also agreed that 1,900 portable electric fires should be provided for bedrooms in existing houses as well as 370 2 kW fires for living rooms, in place of gas fires. These decisions are the result of about a year's negotiations between the Corporation and the South Western Electricity Board.

Seeboard Showroom in Brighton Store

The South Eastern Electricity Board has opened a showroom in the new houseware section of Plummer Roddis departmental store in Western Road, Brighton. At the new showroom consumers will be able to get advice about electrical problems and pay quarterly accounts. As at normal showrooms there is an extensive display of appliances for sale. Miss Elizabeth Allan opened the new showroom on 24th September and Mr. H. Pryce-Jones, J.P., Mid-Sussex area manager, also spoke.

Tummel-Garry Scheme Extensions

The Secretary for Scotland, Mr. James Stuart, has confirmed a scheme prepared by the North of Scotland Hydro-Electric Board to increase the output from the hydro-electric schemes on the Rivers Tummel and Garry, in Perthshire and Inverness-shire, at an estimated capital cost of £1,340,000.

Two new generating stations with a total capacity of 3,900 kW will be built. One will be erected on the eastern shore of Loch Ericht, at the outlet of the existing tunnel from Loch Garry to Loch Ericht. This station will make use of the difference in level between the two lochs and will produce about 9 million kWh annually. The second power station will be built on the Allt Cuaich, a tributary of the River Truim, near Dalwhinnie, in Inverness-shire, to use the difference in level between Loch Cuaich and the up-stream end of an existing aqueduct which leads water from the Allt Cruaich to Loch Ericht. This station will produce about 9,300,000 kWh annually. The scheme also includes the diversion of several burns to the Board's reservoirs, and these diversions will produce nearly 10 million kWh. The existing aqueduct which leads water from the Dunalastair reservoir to the Tummel Bridge power station will be enlarged and the water level raised, increasing the capacity and output of the Tummel Bridge power station and of the Clunie and Pitlochry stations.

Higher Charges in N. Scotland

The North of Scotland Hydro-Electric Board announces that, owing to increased labour, material and money interest costs, it will be necessary to introduce new tariffs as from the date of the first meter readings after 10th October.

At a Press conference in Edinburgh on 30th September, Mr. Thomas Johnston, chairman of the Board, said that the Board had hoped progressively to reduce tariffs or, at any rate, to stabilize them for some years to come, but the rising costs made an increase imperative. Coal costs were up by £150,000 over 1952 and annual interest charges by £400,000. The latter rise was due entirely to the exigencies of the money market and

not to anything the Board had either done or could have avoided doing. Wages and salaries had risen by £230,000 per annum as compared with 1952 as the result of national wage and salary awards and payments in lieu of rates had increased by £80,000 in the same period. An additional factor was that 1955 had been a phenomenally dry year, not only in Great Britain but in Northern Europe. The drought would cost the Hydro Board a considerable amount of money in additional coal costs and in the purchase of energy.

The Board had not increased or altered its tariffs since 1952; in fact, the average price per kWh received from consumers since 1949 until the end of 1954 had increased by only 10 per cent despite the fact that the cost of connecting up new consumers had risen by 80 per cent. It would be difficult to find any other commodity where the average price received had increased so little as electricity had done since 1949.

The Board's existing tariff for residential and non-residential consumers had hitherto been a four-step one. It was now to be a three-step one, the winter rate of ½d which applied in some areas being eliminated. This would mean, on an average, an increase of about 11 per cent on existing charges. Charges for street lighting, traction, battery charging and industrial supplies were also being increased by approximately 11 per cent.

Machkund Project Inaugurated

The Machkund hydro-electric scheme in the Koraput district of Orissa, capable of producing 100,000 kW, went into production recently, the switching-on ceremony being performed by the President of India, Dr. Rajendra Prasad.

Costing Rs.230 million, the project is a joint venture of the States of Andhra and Orissa, the capital costs and power being shared between the two States in the ratio of 70 to 30 respectively. Though jointly owned by the Andhra and the Orissa States, the construction of the project was under the direction and supervision of the Andhra Government Electricity Department. It is designed to supply power to six coastal districts of Andhra and parts of Orissa State. The ultimate capacity is 102,300 kW.

The Machkund scheme is the most important one so far undertaken to develop electricity in the Andhra State. The hydro-electric potential in Andhra is over 1,500,000 kW, obtainable from pure power schemes like Machkund, Sileru, Srissilam, Singereddi and Laximipuram, and irrigation-cum-power schemes like Tungabhadra, Siddeswaram, Nandikonda, Pulichintala and Ramapadasagar. There has been no hydro-electric generation in the State up to the present.

The per capita annual consumption in Andhra is only 5 kWh, compared with an average of 16 kWh for the whole of India.

Laxapana Extensions

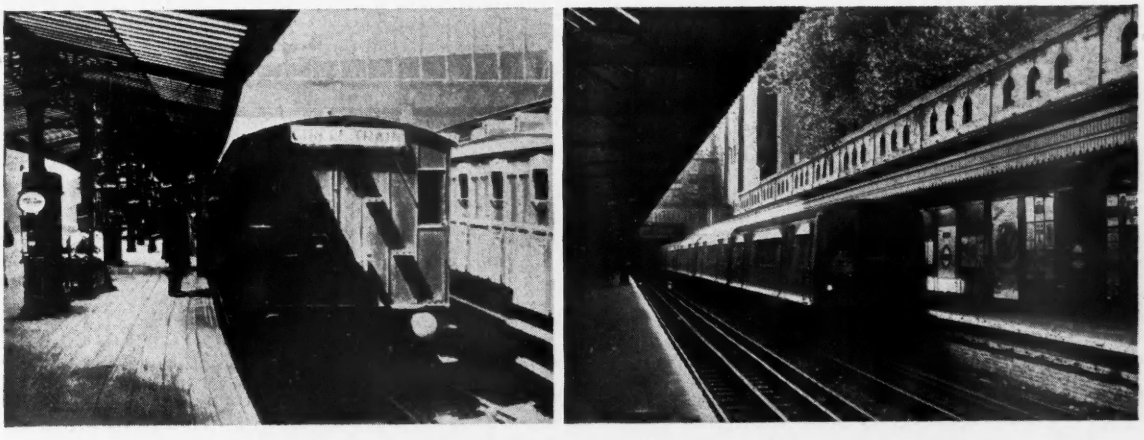
Stage 2-B of the Ceylon hydro-electric scheme at Laxapana, which will give the island an additional 218 million kWh a year by 1961, will cost the Government Rs.116·4 million, states our Colombo correspondent. This is the overall capital cost estimated by Messrs. Preece, Cardew & Rider, consulting engineers, who have just forwarded their report to the Government. Stage 2-B provides for hydro-electric plant and ancillaries, transmission lines and a 25,000 kW steam station.

The consulting engineers say that their proposals represent the maximum economic development of the river and the minimum amount of new steam plant necessary. They recommend that Stage 2-B should comprise three 15,700 kW hydro-electric sets in a new power station between the spillway levels of Castlereigh and Norton reservoirs To make the hydro-electric plant fully effective under all climatic conditions, they recommend that a steam station should be built near Colombo and that the present Colombo power station then be scrapped. The consultants estimate that the steam station and transmission lines would be in service by mid-1960 and the hydro-electric plant would be completed by mid-1961.

Control of Belgian Electricity Industry

The Council of the Federation des Industries Belges (F.I.B.) recently approved a scheme for close co-operation between companies on both the production and distribution sides of the electricity supply industry. This programme, which has been drawn up by a group representing the industry and the trade unions with the collaboration of the F.I.B., will now be submitted for approval by the various companies concerned, and it is also expected that the quasi-municipal undertakings which exist in some areas (*régies*) will adhere to it. It is intended to form an administration committee which will have wide powers to regulate such matters as investment, tariffs, and compensation for local companies eliminated in the course of rationalization; a managing committee to keep a watch on the day-to-day activities of the industry; and a consultative assembly, composed of representatives of producers, trade unions, consumers and provincial and other authorities, which will meet from time to time to discuss all matters raised in the reports of the managing committee.

Apparently this scheme has been drawn up by the industry in the hope of postponing indefinitely the introduction of a proposed Bill establishing a large measure of state control. The F.I.B. has declared that, while it considers that freedom of initiative is best for most enterprises, the special conditions of electricity production and distribution prevent the full exercise of free competition, and a measure of state control has consequently become necessary.



The "Circle" line of London Transport celebrated its fiftieth anniversary last week. The picture on the left shows a steam-hauled train at Mansion House in 1896 and the one on the right the latest type of electric rolling stock at South Kensington station

Financial Section

STOCKS and SHARES

CAUTION has remained uppermost in the Stock Exchange, where Government stocks have made the best showing lately. Under an impression that the Treasury's credit squeeze is doing its work effectively enough at least to reduce the likelihood of a further rise in Bank Rate, investment began to show more interest in the attraction of yields up to 4¾ per cent from gilt-edged securities. In the industrial market activity has again been occupied mainly with new "rights" issues of ordinary shares. Although conditions are anything but favourable for these operations, the tightening up of restrictions on loan and credit facilities has narrowed the courses open to the firm in need of fresh capital. All sections of the market were expecting a fresh lead from Mr. Butler's speech at the Mansion House this week.

Simon-Carves Issue

Despite unfavourable conditions, great success attended the public offer of 850,000 (out of a total issue of 4 million) 5s ordinary shares of Simon-Carves, Ltd., at a price of 22s. Allotments to small public applicants were decided by ballot. Larger subscribers were allotted only small proportions of the amounts applied for. Early dealings in the shares, at the beginning of this week, took place at a premium of about 3s 3d. They are at present 10s paid, with the remaining 12s due by 25th November, and are transferable free of stamp duty for the time being. At an all-in price of 25s the yield is 4½ per cent on the basis of the 22½ per cent dividend which the prospectus indicated for next year, and which would be covered about four times over by earnings at their recent level. The prospectus gave particulars of the group's widespread interests in heavy industrial engineering, and referred to the association with G.E.C. in the field of nuclear power.

New Shares

The premium on English Electric new ordinary shares, offered to stockholders at 60s, improved at one time to over 4s, and although easing subsequently to 2s 9d, remained above the previous week's figure. Other recent issues of ordinary shares in "rights" form also shared firmer tendencies. The premium on new shares issued at 12s 6d by Richardsons Westgarth was 2s 6d, after being 3s. Murphy Radio new 5s ordinary remained at 4s premium on the issue price of 13s. It becomes evident that investment attention is being drawn to situations in which individual issues have become especially depressed by the weight of a large offering of new shares in these unreceptive markets.

Quotations for the shares of the big electrical engineering groups tend to maintain a fairly constant relationship between them, so that an improvement in English Electrics induced at one time a sympathetic rally in others, A.E.I. and C. A. Parsons recovering half-a-crown on previous declines. Improvements were not, however, as a rule retained, and the market reverted

The Week's Price Changes

Company or Board	Nom. Value	Middle price 3rd Oct.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1955 Highest	1955 Lowest
Gilt-edged Stocks								
Brit. Elec. 1968/73	100	79½	+1	3	3	3 15 6	94¾	76½
Brit. Elec. 1974/77	100	77½	+1	3	3	3 17 6	93¾	75½
Brit. Elec. 1976/79	100	83½	+1	3½	3½	4 3 9	98¾	80½
Brit. Elec. 1974/79	100	91½		4¼	4¼	4 14 0	109	90½
Overseas Electric Supply								
Calcutta Elec.	£1	22/-		6†	6†	5 9 0	22/6	20/9
East African Power	£1	21/-		7	7	6 13 4	24/6	19/9
Nigerian Elec.	£1	21/6		10	10	9 6 0	27/-	22/-
Palestine Elec. "A"	£1	21/-		Nil	Nil	—	22/9	21/-
Perak Hydro-Elec.	£1	21/-		6	10	9 10 6	21/6	17/9
Equipment and Manufacturing								
Aberdare Cables	5/-	12/-	−3d	12½	17½	—	14/6	11/-
Aerialite	1/-	6/6		88½	88½	—	6/7	5/3
Allen, W. H.	£1	77/6		20	20	5 3 3	83/9	77/-
Aron Elec. Ord.	£1	60/-		15	15	5 0 0	63/9	55/6
Assoc. Elec. Ord.	£1	80/-		11½	14	3 10 0	96/-	62/6
Automatic Tel. & El.	£1	63/9		15	15*	4 14 0	79/6	63/9
Babcock & Wilcox	£1	80/-	−2/6	12*	15	3 15 0	98/-	68/6
Baldwin, H. J.	2/-	4/6		20	20	8 17 9	5/6	4/4
Bakelite	10/-	32/6		12½	16	4 18 6	34/6	27/-
British Aluminium	£1	51/3	−9d	10	12	4 13 9	58/-	35/3
B.I. Callender's	£1	44/6	−1/6	10	10	4 10 0	55/3	44/9
B.I. Callender's 6% Pref.	£1	21/9		6	6	5 10 3	26/6	21/9
British Thermostat	5/-	31/3		27½	27½	4 8 0	35/-	22/6
British Vac. Cleaner	5/-	7/-		25	30	—	10/-	7/-
Brook Motors	10/-	44/6		20	20*	4 10 0	46/3	39/9
Brush Ord.	5/-	8/3		6	10	6 1 3	9/6	7/7
Bulgin, A. F.	1/-	7/3		30	45	6 4 3	8/-	4/-
Burco Dean	5/-	13/3		—	—	—	17/3	13/3
Chloride El. Storage	£1	66/3		12½	17½	5 5 3	77/6	58/6
Clarke Chapman	£1	97/6	−2/6	20	20*	4 2 0	102/6	68/9
Cole, E. K.	5/-	22/3		27½	17½*	3 18 9	25/6	18/3
Cossor, A. C.	5/-	10/-	−9d	10	15	7 10 0	14/-	8/9
Crabtree	10/-	29/-		17½	20	6 18 0	34/6	29/-
Crompton Parkinson Ord.	5/-	15/6		20	20	—	19/9	16/-
De La Rue	5/-	19/-	−1/-	20	30	7 18 0	26/-	18/9
Decca	4/-	38/3	−1/3	35	56½*	—	48/9	31/-
Desoutter	5/-	33/9		20	25	3 14 0	35/-	25/6
Dewhurst	2/-	10/-		19	24	4 16 0	10/6	7/3
Dictograph Tel.	2/-	7/6	−6d	20	20	5 6 9	9/3	6/6
Dubilier Condenser	1/-	4/3		25	25*	5 17 9	5/7	3/1
E.M.I.	10/-	26/9	−3/3	8	10	3 14 0	37/-	25/3
Electrical Components	5/-	17/-		20	25	7 7 0	21/3	15/3
Elec. Construction	£1	30/9	−1/9	15	8½*	5 10 6	41/3	30/9
Enfield Cable Ord.	£1	20/-		Nil	Nil	Nil	25/3	20/-
English Electric	£1	62/6	+1/3	10	12½	4 0 0	86/9	54/3
English Electric 3¾% Pref.	£1	14/-		3¾	3¾	5 7 3	16/9	14/-
Ericsson Tel.	5/-	40/-	−1/-	25†	25†*	2 10 0†	46/6	29/-
Ever Ready	5/-	30/6	−6d	40	35*	5 14 9	38/-	22/3
Falk Stadelmann	£1	47/6		15	15	—	52/6	42/-
G.E.C. Ord.	£1	62/6		12½	14	4 9 6	80/3	51/3
G.E.C. 6½% Pref.	£1	23/9		6½	6½	5 9 5	28/4	23/6
General Cables	5/-	15/9		30	30	9 10 6	17/-	15/-
Greenwood & Batley	£1	52/6		17½	17½	6 13 4	57/6	52/6
Hackbridge Cable	5/-	21/-	−3d	20	25	5 17 8	22/6	14/-
Hackbridge & Hewittic	5/-	21/3	+6d	25	30	—	24/9	17/-
Hall Tel. Acc.	10/-	26/3		10	10	3 16 0	25/-	11/-
Heatrae	2/-	5/-		12½	15	6 0 0	5/9	4/3
Henley's	10/-	16/3	−6d	10½	10½	6 9 3	21/3	16/3
Holophane	5/-	16/3		20	25	7 13 9	19/9	16/-

* After scrip issue. † Free of income tax.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

to a state of uncertainty. Nervousness in Wall Street has not helped matters here. The strength of Hall Telephones, which were marked up further to 26s 3d, remained a conspicuous exception to the general rule. Hoover "A" shares, at 46s, showed little further change from the initial reaction to the capital proposals.

Electricity Stocks

Last month's improvement in the prices of the British Electricity stocks, although appreciable, still leaves the quotations some 16 to 17 points under those ruling in the early part of the year. Yields remain therefore at levels much higher than anything to which the gilt-edged investor has been accustomed for many years. In addition, with every stock in the list of Government issues standing below par there is, in the case of those redeemable within fixed dates, the assurance of a capital profit upon repayment within a known term of years. From the point of view of current income, the yield of 4·6 per cent on the British Electricity 4¼ per cent stock 1974/79, at about 92, is one of the best returns available from any of the Government "dated" issues (as distinct from others such as Consols and 3½ per cent War Loan, to which no fixed repayment dates are attached). Allowing for the eventual profit of 8 points on redemption at 100, the gross "redemption yield" on the Electricity Stock works out at 4·8 per cent.

in Electrical Investments

Company or Board	Nom. Value	Middle price 3rd Oct.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1955 Highest	1955 Lowest
Equipment and Manufacturing—continued								
Hoover	5/-	41/6		45	70	8 8 9	52/6	40/-
I.C.I.	£1	48/9	−1/-	15	10*	4 2 0	61/9	38/3
Intl. Combustion	5/-	18/6	−6d	20	25	—	24/6	16/3
Johnson & Phillips	£1	42/-		15	15	7 2 10	52/6	41/-
Lancashire Dynamo	£1	50/-		14	15	—	56/6	37/3
Laurence, Scott	5/-	17/6	−6d	20	12½*	3 11 6	19/6	14/6
Lister, R. A.	£1	31/3		12	9·3*	6 0 0	40/-	30/6
London Elec. Wire	£1	52/6	+6d	10	12½	4 15 3	61/3	50/6
Lucas, J.	£1	43/9	−1/3	10·8	7½*	3 8 6	56/6	41/6
Marryat & Scott	2/-	12/3		25	30	4 18 0	13/-	9/6
Mather & Platt	£1	64/6	−1/-	15	13·4*	—	75/-	48/-
Metal Industries	£1	27/6	−6d	9	9	6 11 0	38/-	26/6
Midland Elec. Mfg.	£1	48/9		15	10*	4 2 0	55/-	44/-
Morphy-Richards	4/-	28/9		40	35*	4 15 2	35/-	27/-
Murex	£1	62/6	+1/9	15	15	4 16 0	66/-	49/3
Newman Ind.	2/-	2/9		10	10	7 5 6	3/6	2/4
Oldham & Son	1/-	2/9		17½	20	—	3/6	2/1
Parnall (Yate)	5/-	9/-		8	14	7 15 6	13/2	7/3
Parsons, C. A.	£1	82 6	+2/6	7½	10	2 8 6	100/-	56/-
Plessey	10/-	70/-	−2/6	30	20*	2 17 3	89/-	57/6
Pye Deferred	5/-	22/-	−6d	20	12½*	2 16 9	23/9	14/3
Revo	10/-	13/9		27½	9*	6 11 0	15/6	12/6
Reyrolle	£1	100/-		13¾	15	3 0 0	127/6	89/-
Rheostatic	4/-	12/9		20	22½	—	14/3	9/3
Richardsons Westgarth	5/-	15/3	+3d	15	16¾	5 9 3	19/-	11/-
Scottish Cables	4/-	17/3	−1/6	27½	27½	6 7 6	22/6	17/3
Smith (England), S.	4/-	15/6	−1/-	15	17½	4 10 3	20/-	15/-
Southern Areas	£1	32/6		7½	10	6 3 0	38/-	27/6
Strand Elec.	5/-	8/3	−6d	17½	15*	9 1 9	13/3	8/3
Sturtevant	5/-	30/9	−6d	18·9	14·4†*	2 6 9†	35/9	21/-
Sun. Elec.	£1	35/-		15	15	8 11 6	35/-	33/9
Switchgear & Cowans	5/-	15/-	+1/3	10	20	6 13 3	17/-	11/-
Taylor Tunnicliff	5/-	13/9		12½	15	5 9 0	16/3	11/3
T.C.C.	10/-	48/9		30	25*	5 2 6	53/9	41/-
T.C. & M.	£1	32/6		8½	8½	5 4 7	40/9	32/-
Telephone Mfg.	5/-	10/6		10	10	4 15 3	11/6	9/3
Thorn Elec.	5/-	22/9		20	15*	3 6 0	33/-	13/9
Thornycroft	£1	42/6		15	15	—	47/6	34/6
Tube Investments	£1	95/-	+2/6	15	17½	3 13 9	107/6	72/6
Vactric	5/-	17/6		10	15*	4 5 9	22/-	12/-
Veritys	5/-	10/6	−1/9	12½	12½	5 19 0	12/3	7/-
Walsall Conduits	4/-	14/6		70	70	—	17/3	12/-
Ward & Goldstone	5/-	36/3	+1/3	50	30*	4 2 9	45/-	32/6
Watford	2/-	7/9	−3d	22½	25	—	8/9	6/3
Westinghouse Brake	£1	92/6		16	18	3 18 0	110/-	82/-
West, Allen	5/-	13/6	−3d	17½	15*	5 11 0	16/6	8/-
Wolf Electric	5/-	21/-		17½	20	4 15 3	21/-	16/1
Trusts, Transport and Communications								
Anglo-Am. Tel.:								
A. Ord.	100	69½		6	6	8 12 9	88	67½
Ord.	100	45		3¾	3¾	8 6 8	54¼	45
Anglo-Portuguese	£1	24/6		8	8	6 10 9	27/-	21/-
Brit. Elec. Traction:								
Def. Ord.	5/-	21/-		50	22½*	5 7 3	24/3	19/6
Cable & Wireless:								
Ord.	£1	43/-	−1/6	9	10	4 13 0	54/-	39/6
4% Loan	100	92½		4	4	4 6 6	100	92
Calcutta Trams	£1	25/9	−6d	6†	7½†	5 16 6†	26/3	20/-
Cape Elec. Trams	£1	18/9		5½	7½	8 0 0	19/6	16/6
Marconi Marine	£1	33/9		10	10	5 18 6	41/3	33/-
Oriental Tel. Ord.	1/-	75/-		16	—	—	102/6	72/6
Telephone Rentals	5/-	11/6		10	12½	5 8 9	13/6	9/6

Redemption Profits

In the case of the recently issued 4½ per cent British Electricity Stock 1967/69, the current yield is just on 4·6 per cent and, the price being within 2 points of par, the yield to redemption is only a fraction more. So far as the two 3 per cent British Electricity stocks are concerned, it is the capital profit at redemption which gives them their main attraction. Current yields are under the 4 per cent mark, but both issues are quoted below 80, so that an appreciation of more than 20 points (tax-free) is certain by the time they fall due for repayment between 1968 and 1973 in one case and 1974 and 1977 in the other. Taking these profits into account, the yields to redemption are in the neighbourhood of 4¾ per cent. The position in these stocks is of course calculated to appeal to the surtax payer.

British Relay Wireless

On Wednesday of this week dealings were due to begin in yet another "rights" issue in the shape of the 800,000 new "A" ordinary shares offered to holders of British Relay Wireless & Television "A" and "B" shares. They have the right to subscribe for two of the new shares at 12s 6d, in respect of every five old. The old "A" shares were standing previously at about 16s 6d, at which level the rights were worth about 1s 2d per share. There is no market quotation for the "B" shares, on which the dividend rights are subject to special conditions and which are held by the Pye and Murphy companies.

The above issue by British Relay Wireless is part of an operation to raise £1 million, of which half is being provided by a private placing of preference shares. Some details of the expansion for which the capital is required were given at the company's annual meeting a fortnight or so ago.

REPORTS and DIVIDENDS

British Relay Wireless & Television, Ltd.—Additional capital amounting to £1,000,000 is to be raised by the issue of 800,000 5s "A" ordinary shares and 500,000 6½ per cent £1 cumulative redeemable preference shares. The "A" ordinary shares will be offered at 12s 6d each to ordinary shareholders in the proportion of two for every five "A" or "B" ordinary shares held. Philip Hill, Higginson & Co. have guaranteed the subscription of 520,000 of the "A" ordinary shares and are arranging to place the preference privately at 20s per share. Holders of the "B" ordinary shares will subscribe the remaining 280,000 "A" ordinary shares, being the proportion of the new "A" ordinary shares attributable to the "B" ordinary shares.

George Kent, Ltd. — Provisional allotment letters have now been issued for the rights offer of 400,000 10s ordinary shares at 26s each. Ordinary shareholders are entitled to subscribe on the basis of one for two and to apply for any excess shares. The net proceeds of £613,800 will be applied towards capital expenditure which over the next two or three years is estimated at about £750,000. It is intended to finance the balance out of retained profits. The directors state that they have confidence in the company's ability to maintain the 15 per cent ordinary dividend on the increased capital.

Stothert & Pitt, Ltd., report a trading profit for 1954-55 of £736,281, as compared with £631,411 for the preceding year, and after providing for taxation of £332,300 the net balance is £403,981 (against £325,476). It is proposed to pay a final dividend of 12½ per cent, making 17½ per cent (unchanged). Application is to be made to the Capital Issues Committee for permission to capitalize reserves on the basis of seven new ordinary shares for every 13 issued.

Electrical Components, Ltd.—Particulars are now announced of the offer to ordinary shareholders of 234,907 5s ordinary shares, reference to which was made by the chairman at the recent annual meeting. Shareholders will be offered one new share for every three held at the price of 13s a share.

Simon Carves, Ltd.—Applications for over 15 million shares were received in response to the offer last week of 850,000 5s ordinary shares. Employees are receiving preferential treatment, but allocations to other applicants will be drastically scaled down.

Crossley Brothers, Ltd.—The trading profit for the year ended 30th April last is £445,941, as compared with £407,791 for 1953-54, and after meeting all charges, including £155,309 for taxation, there is a net balance of £170,815 (against £143,733). It is proposed to pay a final dividend of 9 per cent on the deferred ordinary stock, making 12 per cent for the year on capital of £868,591 as increased by 2-for-3 scrip and rights issues. For the previous year the total dividend on the old capital was 17½ per cent.

Irish Electricity Loan.—The lists opened on Monday last and were to close not later than to-day (Friday) for an issue at par of £10 million Irish Electricity Supply Board 5 per cent stock, 1966-75. The stock will be guaranteed by the Government of the Republic. The proceeds will be used to repay short-term borrowings of £5,060,000 and for development works.

Pye (Ireland), Ltd., is holding an extraordinary meeting in Dublin on 12th October to consider a proposal to capitalize £46,666 for a one-for-three scrip issue.

T. Clarke & Co., Ltd., are paying an interim dividend of 10 per cent (against 9 per cent) on increased capital.

The East African Power & Lighting Co., Ltd., has declared an interim dividend of 3 per cent (unchanged).

The Superheater Co., Ltd., is paying an unchanged interim dividend of 10 per cent.

The Telephone & General Trust, Ltd., has announced an interim dividend of 3 per cent (unchanged).

Ericsson Telephones, Ltd., is paying an interim dividend of 4 per cent, tax free (unchanged).

New Companies

Graham Bros. (Electrical Engineers), Ltd.—Registered 16th September. Capital £20,000. To acquire the business of electrical engineers and electricians formerly carried on by C. P. Graham, H. J. A. Graham and C. P. Graham as "Graham Bros." at Middlesbrough. Directors: H. J. A. Graham, C. P. Graham and Katherine B. Graham. Regd. office: Zetland Place, Middlesbrough.

Power Frequency Heating, Ltd.—Registered 14th September. Capital £5,000. Manufacturers of and dealers in electrical, mechanical and hydraulic apparatus, plant, machinery and equipment, etc. Directors: L. W. Seviour, K. C. Derrick and M. M. Kaye. Regd. office: Alexandra Road, Hounslow, Middx.

Electro Washers Hire Service, Ltd.—Registered 3rd September. Capital £1,000. Directors: E. A. Smith and Mrs. Freda Fabian (secretary). Regd. office: 18, Turnpike Lane, Hornsey, N.8.

Electronic Machine Co., Ltd. — Registered 29th August. Capital £1,000. Electronic and automation engineers, etc. Directors: R. W. Newman and P. E. Tooke. Secretary: T. A. Herbert.

Two Stanleys (Birmingham), Ltd.—Registered 29th August. Capital £1,500. Dealers in and manufacturers of electrical goods, etc. Directors: L. S. Webb and S. F. Williams. Solicitors: Wragge & Co., 4, Bennetts Hill, Birmingham, 2.

Increases o Capital

Long and Crawford, Ltd.—Increased by £30,000, in £1 ordinary shares, beyond the registered capital of £20,000.

Fry's (London), Ltd.—Increased by £40,000, in £1 ordinary shares, beyond the registered capital of £30,000.

Dowding & Mills, Ltd.—Increased by £25,000, in 1s ordinary shares, beyond the registered capital of £50,000.

Fife Electrics, Ltd.—Increased by £4,700, in £1 ordinary shares, beyond the registered capital of £300.

Winding-up Petition

Tungsten Electric Co., Ltd.—A petition for the winding-up of this company has been presented to the High Court and will be heard in London on 10th October. Notice of intention to appear at the hearing must be served to Bristows, Cooke & Carpmael, 1, Copthall Buildings, London, E.C.2, solicitors for the petitioner, by 8th October.

Liquidations

Gilbert Electrical Tool Services, Ltd. — Winding up voluntarily. Liquidator, Mr. K. F. Pool, 15, Wellington Circus, Nottingham, appointed 7th September.

Collier Electric (Switches), Ltd.—Members' voluntary winding-up. Liquidator, Mr. A. C. Blake, 199, Piccadilly, London, W.1, appointed 12th September.

Electronics (Leeds), Ltd.—Meeting 1st November at Lillie's Chambers, 39, Albion Street, Leeds, 1, to receive an account of the winding-up by the liquidator, Mr. M. T. Kendrick.

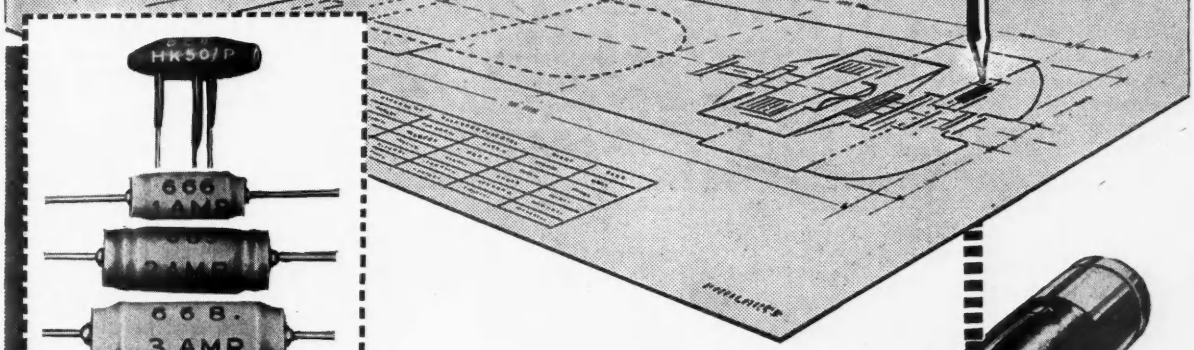
Ward's Electrical Services (Westergate), Ltd.—Meeting of creditors at 8-9, Arcade Chambers, Bognor Regis, on 12th October, for the purposes mentioned in sections 293, 294 and 295 of the Companies Act, 1948. This notice is purely formal as a declaration of solvency has been registered and all creditors will be paid in full.

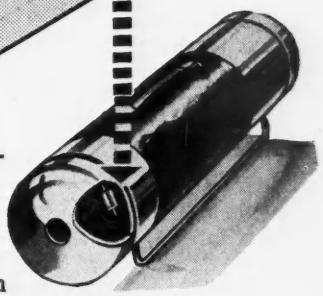
P. L. Dwyer & Co., Ltd., wholesale and retail suppliers of electrical goods. —Last day for receiving proofs for dividend, 8th October. Liquidator, Mr. F. M. Collins, Inveresk House, 346, Strand, London, W.C.2.

Bankruptcy

M. S. Harris, Four Winds, Beech Road, Purley, Berks, electrical engineer.—Receiving order made 20th September on a creditor's petition.

...and, of course, the suppressor goes in here





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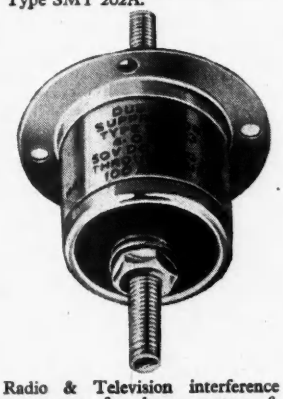

Radio & Television interference suppressor for large motors & generators. Types SBN & SBC.

It cannot be too strongly emphasized that the right time to consider the fitting of interference suppressors is at the drawing board stage. Failure to allow for the suppressor at this stage may result in production hold ups, and a product in which the external appearance has been spoilt due to the addition of a suppressor as an afterthought. It may even necessitate the use of non-standard suppressors entailing protracted delivery.

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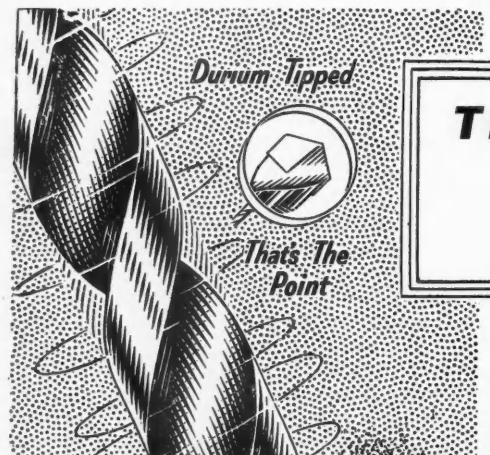

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NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Monday, 10th October

BIRMINGHAM.—Regent House, 6.30 p.m. I.E.E. South Midland Supply & Utilization Group. "The Installation of Metal-Sheathed Cables on Spaced Supports," by W. Holttum.

CARDIFF.—At the South Wales Institute of Engineers, Park Place, 6 p.m. I.E.E. Western Centre. Chairman's address, by T. G. Dash.

HUDDERSFIELD.—The George Hotel, 7.15 p.m. Institution of Production Engineers, East & West Ridings Region, Halifax Section. "Automation—New Tools for Higher Productivity," by F. G. Woollard.

LEICESTER.—Demonstration Theatre, Electricity Offices, Charles Street, 6.45 for 7 p.m. Leicester Electrical Society. "High Quality Sound Reproduction," by A. R. Hawes.

LONDON.—Savoy Place, 6.30 p.m. I.E.E. London Graduates' and Students' Section. Chairman's address, "A.c. Switchgear," by M. H. F. Collins.

St. Ermins Hotel, Caxton Street, 7 p.m. A.S.E.E. Central London Branch. "Cinema Sound and Projection Equipment," by A. H. Richardson.

NEWCASTLE-UPON-TYNE.—Neville Hall, 6.15 p.m. I.E.E. North-Eastern Centre. Chairman's address, by Mr. A. H. Kenyon.

SHEFFIELD.—The University, Western Bank, 6.30 p.m. I.E.S. Sheffield Centre. Chairman's address, by W. Berry.

Livesey Clegg House, 7.30 p.m. Junior Institution of Engineers, Sheffield & District Section. Chairman's address by G. E. H. Peacock and annual general meeting.

Grand Hotel, 7 for 7.30 p.m. Institution of Production Engineers, East & West Ridings Region, Sheffield Section. Annual dinner.

WEMBLEY PARK.—Century Hotel, Forty Avenue, 8.15 p.m. A.S.E.E. North-West London Branch. "Magnetic Amplifiers," by F. E. Spooner.

Monday, 10th October, to Friday, 14th October

LONDON.—Seymour Hall. London Nursing Exhibition & Professional Nurses' & Midwives' Conference.

Tuesday, 11th October

BELFAST.—Queen's University, 6.30 p.m. I.E.E. Northern Ireland Centre. Chairman's address, "Problems and Progress in Electricity Distribution," by Major E. N. Cunliffe.

BRADFORD.—I.E.E. North Midland Graduates' & Students' Section, 7 p.m. "Earth Currents," by J. R. Bennett.

CAMBRIDGE.—Cambridgeshire Technical College, Collier Road, 6 p.m. I.E.E. Cambridge Radio & Telecommunication Group. Chairman's address, by Brigadier E. J. H. Moppett.

DARLINGTON.—Technical College, 7 p.m. Institution of Production Engineers, Northern Region, Tees-Side Section. "The Practical Uses of Electronics in Industry," by K. A. Zandstra.

EDINBURGH.—11, Atholl Crescent, 7.30 p.m. Edinburgh Electrical Society. Presidential address, "Rectification, an Historical Survey," by O. L. Robson.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Measurement & Control Section. Chairman's address, by W. Bamford.

At the Royal Institution, Albemarle Street, 6 p.m. Illuminating Engineering Society. Presidential address by A. G. Higgins.

Connaught Rooms, W.C.2, 12.30 for 1 p.m. Electrical Industries Club. Luncheon. Guest speaker, Capt. P. P. Eckersley.

LOUGHBOROUGH.—The College, 7 p.m. I.E.E. East Midland Centre. Chairman's address, by F. R. C. Roberts, and annual general meeting.

MANCHESTER.—Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Utilization Group. "The Installation of Metal-Sheathed Cables on Spaced Supports," by W. Holttum.

RUGBY.—College of Technology & Arts, 6.30 p.m. I.E.E. Rugby Sub-Centre. Chairman's address, "Development and Research in Electrical Machine Design," by L. D. Anscombe.

SLOUGH.—Community Centre, Farnham Road, 7.30 p.m. Institute of Welding, Slough Section. "Recent Advances in Welding Processes and Plant," by Dr. J. H. Paterson.

Wednesday, 12th October

ABERDEEN.—Caledonian Hotel, 7.30 p.m. I.E.E. North Scotland Sub-Centre. "Electrical Energy from the Wind," by E. W. Golding.

BIRMINGHAM.—James Watt Institute, 6.30 p.m. I.E.E. South Midland Students' Section. Chairman's address, "Properties and Applications of Some Recent Semiconductor Devices," by J. W. Winterbottom.

Chamber of Commerce, New Street, 7.15 p.m. A.S.E.E. Birmingham Branch. Lecture by a member of the British Interplanetary Society.

CAMBORNE.—Cornwall Technical College, Trevenson, 7 p.m. I.E.E. South-Western Sub-Centre. "The Domestic Heat Pump," by G. O. McLean.

FARNBOROUGH.—R.A.E. Technical College, 7.30 p.m. I.E.E. Southern Centre. James Clayton Lecture: "Nuclear Reactors and Power Production," by Sir Christopher Hinton. (Joint meeting with the Southern Branch of the Institution of Mechanical Engineers.)

HALIFAX.—Crown Hotel, Horton Street, 7.30 p.m. A.S.E.E. Halifax Branch. Inaugural meeting. Address by the general secretary, followed by the Electrical Engineers' Exhibition film.

LIVERPOOL.—Exchange Hotel, 7.30 p.m. Institution of Production Engineers, North West Region, Liverpool Section. "The Application of Radioisotopes in Industry," by Dr. Henry Seligman.

LONDON.—I.E.E. London Graduates' & Students' Section. Visit to the Plessey Co., Ltd., Ilford, at 2 p.m.

Connaught Rooms, Great Queen Street, W.C.2, 6.15 for 7 p.m. The Institute of Fuel. Annual dinner and dance.

At St. Bride Institute, Bride Lane. Institution of Engineers-in-Charge. Presidential address, by R. L. Quertier.

E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, 6 p.m. Royal Statistical Society, Study Section. "A Research Design for Studying the Effects of Television," by W. A. Belson.

MANCHESTER.—Engineers' Club, Albert Square, 6.45 p.m. I.E.E. North-Western Radio & Telecommunication Group. "A Diffused Impurity Germanium Junction Photo-Electric Cell," by J. M. Waddell, Dr. S. E. Mayer and S. Kaye; "Transistor d.c. Converters," by L. H. Light and P. M. Hooker; and "Transistor Power Amplifiers," by R. A. Hilbourne and D. D. Jones.

NORWICH.—Assembly House, 7.30 p.m. I.E.E. East Anglian Sub-Centre. Chairman's address, by E. T. Norris.

OXFORD.—37, George Street, 7 p.m. I.E.E. district meeting. "The New High-Quality F.M. Broadcasting Network," by H. Page.

PRESTON.—N.W.E.B., 19, Friargate, 7.15 p.m. I.E.E. North Lancashire Sub-Centre. Chairman's address, by W. Ward.

WIMBLEDON.—Guild House, 32, Worple Road, 8.15 p.m. A.S.E.E. South-West London Branch. Branch lecturettes: "Underfloor Ducting Distribution," by J. T. Martin, and "Light and the Eye," by C. F. Oliver.

WOLVERHAMPTON.—Wolverhampton & Staffordshire Technical College, 7.15 p.m. British Institution of Radio Engineers, West Midlands Section. "Frequency Modulation Broadcasting and Reception," by H. E. Farrow.

YORK.—"Shambles Café," 7.15 p.m. A.S.E.E. York Branch. "Power Factor Improvement," by R. G. N. Soper.

Wednesday, 12th October, to Friday, 14th October

LONDON.—Royal Horticultural Society's New Hall, S.W.1. Engineering Industries Association, 8th London Regional Display.

Wednesday, 12th October, to Saturday, 22nd October

MANCHESTER.—City Hall. Fuel Efficiency Exhibition.

Thursday, 13th October

DUNDEE.—Queen's College, 7 p.m. I.E.E. North Scotland Sub-Centre. "Electrical Energy from the Wind," by E. W. Golding.

GLASGOW.—Royal Technical College, 7.30 p.m. I.E.E. South West Scotland Sub-Centre. "An Outline of Developments in Electric Power Stations," by C. W. Marshall. (Joint meeting with the Institution of Mechanical Engineers.)

425/427, Sauchiehall Street, 7 p.m. Incorporated Plant Engineers, Glasgow Branch. "Hermetically Sealed Refrigerating Equipment," by A. K. Alcock.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Utilization Section. Chairman's address, by D. B. Hogg.

SWANSEA.—S. Wales Electricity Board Showrooms, The Kingsway, 6 p.m. I.E.E. West Wales (Swansea) Sub-Centre. Chairman's address, by J. H. Groocock.

Friday, 14th October

COVENTRY.—Masonic Hall, 7.30 p.m. Institution of Production Engineers, Midlands Region, Coventry Section. Dinner and dance.

GLASGOW.—Royal Technical College, 7 p.m. Institute of Fuel, Scottish Section. "Development of Slurry Handling Plant at Barony Power Station," by J. R. Croucher.

LIVERPOOL.—Stork Hotel. Incorporated Plant Engineers, Merseyside & North Wales Branch. Annual dinner.

LONDON.—Caxton Hall, 6.30 p.m. E.P.E.A., Southern Meter Engineers' Group. "Some Impressions of America," by L. H. Welch.

Pepys House, 14, Rochester Row, 7 p.m. Junior Institution of Engineers. "Some Interesting Axial Flow Fan Applications," by R. C. Dick.

STOKE.—North Stafford Hotel, 8 p.m. A.S.E.E. Stoke & Crewe Branch. "Metal Rectifiers."

Saturday, 15th October

LONDON.—I.E.E. London Graduates' & Students' Section. Visit to Sadler's Wells Theatre, at 10 a.m.

Sunday, 16th October

LONDON.—Gaumont-British Theatre, Film House, Wardour Street, 11 a.m. British Kinematograph Society. Symposium on "New Trends in Projector Light Sources and Power Supplies."

Illumination Design Course

The 71st Illumination Design Course arranged by the Lighting Service Bureau will begin on 31st October and continue on consecutive Monday evenings until 12th December. Lectures will begin at 7 p.m.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 9th November from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1950

2262. Electric & Musical Industries, Ltd. —Computing apparatus. 15th January, 1951. (740071.)

22083. Alexander, P., Baxter, A. S., and Boston, M. E.—Terminal connections for electric heating elements. 24th August, 1951. (740073.)

1951

21367. Mullard Radio Valve Co., Ltd.— Television receivers. 11th December, 1952. (740354.)

21685. British Telecommunications Research, Ltd.—Frequency dividers. 15th September, 1952. (740241.)

1952

4169. Rangabe, A. R., and Buckingham, J.—Manufacture of electron discharge devices. 12th May, 1953. (740243.)

12140. Telefonaktiebolaget L. M. Ericsson.—Electron discharge device for microwaves. 13th May, 1952. (740358.)

17898. British Communications Corporation, Ltd., and Heftman, T. S.—Portable radio apparatus for use in distress at sea. 14th July, 1953. (740360.)

20712. British Thomson-Houston Co., Ltd.—Electromagnetic circuit-breakers. 10th August, 1953. (740361.)

21529. Svenska Aktiebolaget Gas-Accumulator.—Automatic radio direction-finding systems. 27th August, 1952. (740362.)

27177. International Business Machines Corporation.—Trigger and counter circuits. 29th October, 1952. (740367.)

28162. Radio Corporation of America.— Noise cancellation circuit for synchronization pulse separator circuit in a television receiver. 7th November, 1952. (740370.)

30816. Metropolitan-Vickers Electrical Co., Ltd.—Apparatus for resolving electrical waveforms. 20th January, 1954. (740163.)

32658. Bylock Electric, Ltd.—Floor polishing machines. 23rd December, 1953. (740250.)

1953

1646. Brush Electrical Engineering Co., Ltd.—Electrical control systems. 12th June, 1953. (740376.)

2515. Heybroek-Zelander N.V.—Holders for electric lighting tubes. 28th January, 1953. (740261.)

4125. Gossen & Co. Ges., P.—Electric contact devices having magnetic means for increasing the contact pressure. 13th February, 1953. (740262.)

4422. Fernseh Ges.—Cathode-ray tubes. 17th February, 1953. (740263.)

4908. Lucas (Industries), Ltd., J.— Electromagnets. 17th February, 1954. (740264.)

5437. National Research Development Corporation.—Electrical phase-shift testing equipment. 24th February, 1954. (740010.)

5679. Thorpe, Ltd., F. W., and Thorpe, E. G.—Fluorescent electric lighting installations. 27th May, 1954. (740383.)

7286. Babcock & Wilcox, Ltd.—Tubulous vapour generators and a method of firing such generators. 17th March, 1954. (740167.)

9604. Electric & Musical Industries, Ltd. —Electron discharge devices. 10th March, 1954. (740266.)

9964. Westinghouse Electric International Co.—Gaseous electric discharge devices. 13th April, 1953. (740267.)

10470. General Electric Co., Ltd., and Maer, C. A.—Control systems for electric motors. 14th April, 1954. (740256.)

11362. English Electric Co., Ltd.— Hydraulic turbines. 23rd April, 1954. (740169.)

11383. General Electric Co., Ltd., Friedlander, E. S., and Parton, K. C.—Control systems for electric motors. 22nd April, 1954. (740257.)

11975. Wolf Electric Tools, Ltd.—Electrically driven tools. 30th April, 1953. (740270.)

12118. Western Electric Co., Inc.—Line testing circuits comprising automatic routines. 1st May, 1953. (740389.)

12356. Automatic Electric Laboratories, Inc.—Electronic ringing current generator. 4th May, 1953. (740258.)

13676. Research Corporation.—System for energizing electrical precipitators. 15th May, 1953. (740394.)

17035. Standard Telephones & Cables, Ltd.—Electrical multiplication circuit. 19th June, 1953. (740404.)

17372. English Electric Co., Ltd.—Electric motor control systems. 23th June, 1954. (740402.)

18273. Telemecanique Electrique.— Thermally operated protective devices for polyphase circuits. 1st July, 1953. (740282.)

19072. Siemens-Schuckertwerke Akt.-Ges.—Electric protective and control apparatus. 9th July, 1953. (740411.)

20812. Moulon, J. M.—High stability transistor oscillators. 27th July, 1953. (740417.)

21465. Philips Electrical Industries, Ltd. —Trigger circuits. 4th August, 1953. (740284.)

22381. Sylvania Electric Products, Inc.— Manufacture of area junction semi-conductor devices. 13th August, 1953. (740419.)

24209. Siemens Bros. & Co., Ltd.—Telephone systems. 20th August, 1954. (740424.)

26190. Hoover, Ltd.—Steam irons. 23rd September, 1953. (740175.)

29420. Landis & Gyr, Ltd.—Testing of electricity meters. 23rd October, 1953. (740430.)

31529. Philips Electrical Industries, Ltd. —Receivers for frequency shift telegraphy. 13th November, 1953. (740298.)

32329. Deutsche Edelstahlwerke Akt.-Ges.—Metal electrodes and a process for the production thereof. 20th November, 1953. (740300.)

32724. Philips Electrical Industries, Ltd. —Circuits for producing pulses. 25th November, 1953. (740021.)

36192. Telefonaktiebolaget L. M. Ericsson.—Automatic or semi-automatic telephone systems. 30th December, 1953. (740302.)

1954

180. Metallges. Akt.-Ges.—Electrostatic precipitators. 4th January, 1954. (740091.)

208. Philips Electrical Industries, Ltd.— Devices comprising magnetic cores. 4th January, 1954. (740304.)

477. Garnerot & Co. (Consolidated Agencies), Ltd.—Means for mounting electrical junction boxes. 7th January, 1954. (740093.)

612. British Thomson-Houston Co., Ltd. —Production of shaped metal bodies having internal cavities, such as magnetron anodes. 8th January, 1954. (740182.)

959. Singer Manufacturing Co.—Electronic seaming machines. 13th January, 1954. (740186.)

1004. Telefunken Ges., formerly Telefunken Ges. für Drahtlose Telegraphie.— Arrangements for coupling a coaxial high-frequency line to a load having a symmetrical input. 13th January, 1954. (740187.)

2208. Kearfott Co., Inc.—Dynamo-electric machines and method of making same. 25th January, 1954. (740115.)

2537. Aktieselskabet Fisker & Nielsen.— Silencing of vacuum cleaners. 27th January, 1954. (740199.)

2640. Ronsch, K.—Electrically heated baking and roasting utensil for household use. 28th January, 1954. (740200.)

3325. Compagnie Générale de Télégraphie sans Fil.—Radioelectric distance measuring systems. 4th February, 1954. (740207.)

3360. Lumalampan Aktiebolag.—Method of applying a coating in powder form to the inside surface of a lamp bulb and a device for carrying out the method. 4th February, 1954. (740096.)

3417. Elektrokemisk Aktieselskap.— Arrangements of the busbars of electrolytic furnaces. 5th February, 1954. (740025.)

4900. Westinghouse Electric International Co.—Electric circuit interrupters. 19th February, 1954. (740031.)

5539. Allmanna Svenska Elektriska Aktiebolaget.—Combined disconnecting switch means and fuse protection means for a branch from an electric high tension overhead line. 25th February, 1954. (740102.)

6247. Rusinòl, S. P.—Voltaic cells. 3rd March, 1954. (740218.)

8106. Standard Telephones & Cables, Ltd.—Electrical connector arrangement. 19th March, 1954. (740222.)

8283. Forges et Ateliers de Constructions Electriques de Jeumont.—Speed indicating and automatic control system for electric motors. 22nd March, 1954. (740033.)

8340. General Electric Co.—Rotary fluid flow measuring apparatus. 22nd March, 1954. (740037.)

8492. Hynes, L. P.—Electric heater lines. 23rd March, 1954. (740043.)

8878. Felten & Guilleaume Carlswerk Akt.-Ges.—Deep submarine electric cable. 26th March, 1954. (740326.)

10034. Standard Telephones & Cables, Ltd.—Electric trigger circuits employing crystal triodes. 6th April, 1954. (740056.)

10838. Standard Telephones & Cables, Ltd. (Federal Telecommunication Laboratories, Inc.).—Electrical signal translating system. 13th April, 1954. (740060.)

11114. Elektrokemisk Aktieselskap.— Electrolytic aluminium furnaces. 15th April, 1954. (740063.)

11690. Philips Electrical Industries, Ltd. —Method of sealing glass to enamelled iron, more particularly a window to a cone of a cathode-ray tube. 22nd April, 1954. (740331.)

11986. Philips Electrical Industries, Ltd. —Amplifying circuit arrangements comprising a plurality of transistors. 26th April, 1954. (740333.)

12318. Philips Electrical Industries, Ltd. —Electric coils. 28th April, 1954. (740336.)

12503. Landis & Gyr Akt.-Ges.— Maximum demand meter. 29th April, 1954. (740341.)

12875. United States Rubber Co.—Insulated electrical conductor and method of making same. 4th May, 1954. (740342.)

13748. Foster Wheeler, Ltd.—Steam generators. 11th May, 1954. (740132.)

14561. Philips Electrical Industries, Ltd. —Carrier telegraph receivers. 18th May, 1954. (740065.)

16553. Van Der Heem N.V.—Suction cleaners. 4th June, 1954. (740134.)

16999. Hutchins Electric Co., Inc.— Electric motors. 9th June, 1954. (740136.)

17205. Ateliers de Constructions Electriques de Charleroi.—System for speed regulating electric motors with current limitation. 11th June, 1954. (740137.)

18693. Philips Electrical Industries, Ltd. —Beam restricting means for attachment to X-ray apparatus. 25th June, 1954. (740139.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Ashington (Northumberland). — U.D.C. Electrical installation in 40 flats on the Beamsley Terrace site, Ashington. Surveyor, Council Offices.

Clydebank.—22nd October. Corporation. Street lighting equipment. (See this issue.)

Devon.—County Council. Street lighting equipment. (See this issue.)

Formosa.—17th October. Central Trust of China, Taipei. Power cables and accessories. (E.S.B. 19845/55. Ten/15797.)* 19th October. Meters and metering equipment. (E.S.B. 19850/55. Ten/15803.)* 20th October. Air break switches and accessories. (E.S.B. 20206/55. Ten/15804.)* Radiator with fans for 3,000 kVA unit substation. (E.S.B. 20207/55. Ten/15806.)* 21st October. Mobile unit substation. (E.S.B. 20208/55. Ten/15807.)*

India.—21st October. Director General of Supplies and Disposals, New Delhi. Centrifugal pumping sets with spares. (E.S.B. 20588/55. Ten/15840.)*

20th October. Government of Madras Electricity Department. Outdoor and indoor switchgear. (E.S.B. 20681/55. Ten/15846.)*

1st December. Government of Andhra Electricity Department, Madras. Extensions to outdoor switchgear for the Machkund hydro-electric scheme. (E.S.B. 20341/55. Ten/15789.)*

Leeds.—5th November. Corporation. Street lighting equipment. (See this issue.)

London.—Dismantling of existing electrical installation and the complete re-wiring of St. Antony's Church, St. Antony's Road, Forest Gate, E.7. Rev. D. O'Sullivan, The Friary, Forest Gate.

Longbenton.—25th October. U.D.C. Equipment for 40 houses, including electrical installations. (See this issue.)

Middlesbrough.—24th October. Tees Valley Water Board. Additional 150 h.p. slipring motor and vertical centrifugal pump, together with switchgear, etc., at the Fighting Cocks pumping station, near Darlington. T. S. R. Winter, general manager, Corporation Road.

New Zealand.—24th October. Wellington Electricity Department. A.c. meters. (E.S.B. 20844/55. Ten/15884.)*

3rd November. Director-General, Stores Division, G.P.O., Wellington. Insulator spindles. (E.S.B. 20391/55. Ten/15780.)*

Nicaragua.—2nd December. National Light & Power Co. of Managua. Transmission lines, substations and electrical distribution systems. (E.S.B. 20346/55. Ten/15786.)*

Northampton.—24th October. Corporation. Street lighting equipment. (See this issue.)

Portuguese East Africa.—13th December. Ports, Railways and Transport Department, Lourenco Marques. Copper wire, insulators and spindles, crossarms and transpositions. (E.S.B. 20002/55. Ten/15725.)*

South Africa.—14th October. Stores Department, South African Railways, Johannesburg. Insulated electric cable. (E.S.B. 20139/55. Ten/15885.)* 28th October. Electric capstans. (E.S.B. 20401/55. Ten/15779.)*

28th October. Durban Electricity Department. 33 kV underground cable. (E.S.B. 20568/55. Ten/15836.)*

Turkey.—14th November. H.Q. Allied Land Forces, South Eastern Europe, 12 MIR. Automatic switchgear. (E.S.B. 20551/55. Ten/15863.)*

Watford.—Corporation. Street lighting equipment. (See this issue.)

West Hartlepool.—Corporation. Electrical installation in the new Brierton County Secondary School. Borough architect, Municipal Buildings, West Hartlepool.

*** Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).**

ORDERS PLACED

Caerphilly.—U.D.C. Fifty-three Group "A" lighting standards fitted with 140 W sodium lamps and lanterns at Nelson (£4,493). —Revo Electric Co.

Gosport. — Corporation. Recommended. Electric street lighting (£1,699).—Southern Electricity Board.

Lancashire.—County Council Education Committee. Electrical installation work at Leigh Sacred Heart R.C. (Aided) School (£1,283).—S. H. Heywood & Co.

London.—Greenwich Works Committee. Recommended. Lamp columns, lanterns and control gear and the removal of cast iron gas columns in connection with conversion of side street lighting from gas to electricity (£72,172).—Revo Electric Co.

Romford.—Corporation. Recommended. Conversion of street lighting from gas to electricity (£22,851).—Harland & Wolff.

Sedgley.—U.D.C. Electrical installations in dwellings on the Stickley Lane (Extension No. 2) housing site (£2,482).—A. & V. Baxter.

Stockport.—Corporation. Recommended. Electrical installations to 36 dwellings at Brinnington, Contract 35 (£1,063) and 68 dwellings, Contract 36 (£2,042).—A. B. Davenport (Electrical Contractors).

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Aberdare. — Pithead baths, Aberman Colliery; National Coal Board, Mount Stuart Square, Cardiff.

Alnwick.—Houses (93), and two shops at Shilbottle, for R.D.C.; Reavell and Cahill, architects, Lloyds Bank Chambers.

Alperton.—Showrooms and offices; Dagenham Motors, Ltd., 374, Ealing Road.

Antrim.—Intermediate school at Hilden, Lisburn; Vincent B. Evans, quantity surveyor, 3, Bradbury Place, Belfast.

Armagh.—Lurgan Boys' and Lurgan Girls' County Intermediate Schools, a central school meals kitchen, two dining halls, etc., for Armagh County Education Committee (£240,970); Collen Bros. Schools at Tullyroan (£10,671) and Clare (£10,364); McKinney & Co., Tandragee.

Barnsley.—Eight-bay fire station at Broadway; C. R. Hollingsworth, borough surveyor, Town Hall.

Beeston.—Office building, Station Road; Gee, Walker & Slater, Ltd., builders, Uttoxeter Old Road, Derby.

Belfast.—Cinema, Castle Street, for Odeon Theatres, Ltd.; Sir Alfred McAlpine & Sons, Ltd., builders, Little Sutton, Wirral.

Birmingham.—Development of site, Corporation Street/Bull Street/Temple Row/Cherry Street; Harrods, Ltd., Knightsbridge, London, S.W.1.

Dwellings (133), Bell Holloway estate, Northfield; city architect.

Bishop Auckland.—Central bus station; surveyor, U.D.C. Offices.

Bradford.—County junior school, Halifax Road (£54,208), and R.C. secondary school, Rooley Lane (£148,104); W. H. Leathem, town clerk, Town Hall.

Brighton.—Eight secondary schools; D. J. Howe, borough surveyor, King's Road.

Fire station, Roedean; A. C. Jenkins, Ltd., Barn Garage, Ladies Mile Road, 6.

Bristol.—Terminal buildings at Lulsgate Aerodrome; city architect.

Dwellings (124), Hartcliffe; Selleck Nicholls & Co., Ltd., East Hill, St. Austell.

Burnley.—Grammar school, Ivy Bank; borough surveyor.

Camborne.—Shops, showrooms and offices, High Street; Charterbridge Corporation, Ltd., 8a, Eccleston Street, London, S.W.1.

Cheltenham.—Houses (60), Ashchurch, Winchcombe, Deerhurst, Shurdington and Witcombe, for R.D.C.; E. H. Rosser, surveyor, 14, Imperial Square.

Shops, flats and maisonnettes, Lynworth estate; borough surveyor, P.O. Box 12, Cheltenham.

Chesterfield.—Block of 18 flats and further 150 houses, Old Whittington; borough architect.

Bus station, Tontine Road, for East Midland Motor Services, Ltd.; M. J. Gleeson, Ltd., Sheffield.

Clowne (Derbys).—Four blocks of flats, Station Road, Whitwell, for R.D.C.; Dernie & Bell, Ltd., Worksop, Notts.

Cockermouth.—Houses (54), Park Lane estate; North-Eastern Housing Association, Curzon House, Maryport.

Colne.—Dwellings (72), Venables Avenue and Keighley Road; borough surveyor.

Consett.—Two schools on the Moorhouse estate; county architect, Court Lane, Durham.

Coventry.—Further instalment of City of Coventry Training College, Canley; W. H. Jones & Son, Ltd., Holbrook Lane.

Daventry.—Daventry Secondary Modern School; Bosworth & Wakeford, Ltd., New Street, Daventry.

Doncaster.—Three-storey block of flats at Cantley (£45,000); borough architect, 15, South Parade.

Durham.—Convent at Burn Hall, St. Joseph's Foreign Mission College (£30,000); R. Burke, architect, Lambton Road, Newcastle-on-Tyne.

Eastbourne.—Factory and warehouse, Brampton Road estate; Edward E. Lazarus, Ltd., 51, Bartholomew Close, London, E.C.1.

Eccles.—Office building and canteen, Silk Street, for Shell Mex & B.P., Ltd.; N. J. Skeet, Handforth Road, Wilmslow.

R.C. school, Guilford Road; F. A. Kerr, architect, 134, Deansgate, Manchester.

Edmonton.—Works, Montague estate; B. Stitcher & Sons, Ltd., Somers Road, London, E.17.

Failsworth.—Civic hall and library, Pole Lane; U.D.C. surveyor.

Glasgow.—Multi-storey building on the Argyle Street/Queen Street/Miller Street site (£900,000), for Littlewood's Mail Order Stores, Ltd.; Keppie & Henderson & Gleave, architects, 21, Woodside Place.

Gloucester.—Magistrates' court, police station, health clinic, etc., at Dursley; G. H. Davies, clerk. Gloucestershire Standing Joint Committee, Gloucester.

Halifax.—County primary school, Ash Tree (£47,432) and extensions to Heath Grammar School (£17,000); borough surveyor, Crossley Street.

Hartlepool.—Additions to the works (£2,000,000); Steetley Magnesite Co., Ltd.

Huddersfield.—Hospital on the Green Lea site, in phases; W. A. Shee, secretary, Leeds Regional Hospital Board, Park Parade, Harrogate.

Kingsbury.—Works extensions; Vanden Plas (Engineering), Ltd., Kingsbury Road.

Leeds.—Rebuilding departmental store; Schofields (Leeds), Ltd., drapers, etc., 79, The Headrow.

Liverpool.—Factory for Kraft Foods, Ltd.; Howard Crane & Partners, architects, 7, Buckingham Gate, London, S.W.1.

London.—Seamen's home, Belvedere Park, S.E. (£200,000), for the Royal Alfred Merchant Seamen's Society; secretary, Ibex House, Minories, E.C.3.

Offices, Bartletts Building, Thavies Inn and St. Andrew Street; Brixton Development Co., Ltd., 22, Ely Place, E.C.1.

Office block, Mandeville Place; Griggs & Sons, Ltd., builders, 53, Victoria Street, S.W.1.

Flats (128), Traverton Street; Rider, Hunt & Partners, surveyors, Bridge House, Queen Victoria Street, E.C.4.

Maidenhead.—Factory (£150,000); Donald Hamilton, Wakeford & Partners, architects, 7, Connaught Place, Hyde Park, London, W.2.

Manchester.—Child welfare clinic at Moorcroft Road, Northern Moor; city architect, Town Hall.

Abattoir, cold stores and meat market proposed; city architect.

Factory, Wythenshawe estate, for Disincrustant Marseillais, Ltd.; Fred Mitchell & Son, Ltd., River Place, City Road.

Middlesbrough.—Factory at Tackenby, Grangetown; British Oxygen Co., Ltd.

Houses (55), Pallister Park; J. A. Kenyon, borough engineer.

Morecambe.—Houses (500), and shops proposed as new estate at Westgate; F. Fisher, developer, 169, West End Road.

Newcastle-on-Tyne.—Old people's home, Montagu estate (£60,000); city architect, 18, Cloth Market, Newcastle.

Block of offices, Pilgrim Street and City Road; Prudential Assurance Co., Ltd.

Block of offices, Cross House site, Westgate Road; Cackett, Burns Dick & McKellar, 21, Ellison Place.

Newcastle-under-Lyme. — Three-storey flats, Fletcher Street; Tideswell Bros., Ltd., Brick Kiln Lane, Basford, Stoke-on-Trent.

North Riding.—Primary school, Colburn (£36,000); John McCreton, Ltd., builders, King's Road, North Ormesby, Middlesbrough.

Nottingham.—In connection with the proposal to erect a hotel, flats, open-air theatre and gymnasium for the University Authorities, mentioned in our issue of 16th September, Mr. G. A. Jellicoe, the architect, informs us that work will not commence for some time to come and he asks contractors not to approach him on the matter at the present time.

Reading.—R.C. secondary modern school, Bath Road; W. H. Saunders & Son, architects, 1, Carlton Crescent, Southampton.

Richmond (Yorks).—Police station on Hill House estate (£40,000) and children's home on Cutpurse Lane estate; county architect, County Hall, Northallerton.

Romford.—Large offices, etc., in Hornchurch Road; Roneo, Ltd., 17, Southampton Row, London, W.C.1.

Ruislip.—Crematorium; Ruislip-Northwood and Uxbridge Joint Crematorium Board, Oaklands Gate, Northwood.

St. Helens.—Carr Mill Primary Junior School; Gornall, Kelly & Partners, architects, 8, Hardshaw Street.

Scarborough.—Factory additions, Seamer Road, for Messrs. Tesseyman; E. Allen, architect, 32, St. Nicholas Street.

Stamford.—Group laundry at Stamford and Rutland Hospital; Hoare, Lea & Partners, consulting engineers, 23, St. James's Road, Edgbaston, Birmingham.

Sutton Coldfield.—Houses (50), off Eachelhurst Road; Falamore, Ltd., 7, Newhall Street, Birmingham.

Todmorden.—R.C. school; Greenhalgh & Williams, architects, 15, Mawdsley Street, Bolton.

Wembley.—Offices and warehouse, South Way; Erma, Ltd., Hong Kong Works, Exhibition Grounds.

Works reconstruction; Drings, Ltd., Second Way, Exhibition Grounds.

Weston-super-Mare. — Divisional fire brigade headquarters for County Fire Brigade Committee; R. O. Harris, county architect, Park Street, Taunton.

Whitehaven.—Houses (68), at Loop Road South; James Leslie & Sons, Coach Road.

Church at Mirehouse, for C. of E. Authorities; John Laing & Son, Ltd., Dalston Road, Carlisle.

Whitley Bay.—Shirt factory on the Foxhunters estate; A. Briggs and Co., solicitors for the promoters, 228, Park View, Whitley Bay.

Williton.—Houses (38), in five parishes; R.D.C. surveyor, Council Offices, Fore Street-Williton, Somerset.

Workington.—Maternity unit at Workington Infirmary for Newcastle Regional Hospital Board; Simpson, Oldfield & Saul, architects, National Provincial Bank Chambers, John Street.

Yeovil.—Houses (143), to be erected next year; A. Heal, borough surveyor, Municipal Offices, King George Street.

Canadian Electrical Imports

Canadian imports of electrical apparatus last year showed a slight increase on 1953. The total value was $207,500,000, compared with $198,250,000. Thus the advance (of 40 per cent) which took place between 1952 and 1953 was continued.

There were decreases in the imports of power plant, notably steam generators and the larger sizes of motors, but these were offset by increases in telephone apparatus, radio goods n.o.p., meters and some of the smaller apparatus. The share of the United Kingdom tended to be lower in a number of lines. Group totals for 1954 with notes of increases or decreases on the previous year are tabulated below.

Class of Goods	1954 $ (000)	Inc. or dec. on 1953 $ (000)
Batteries, flashlight, and parts	129*	− 1
Batteries, hearing aid, and parts	503*	+ 15
Batteries, storage, n.o.p.	1,836	+ 513
From U.K.	246	+ 118
,, *U.S.A.*	1,567	+ 376
Battery, primary, n.o.p.	321	− 74
From U.K.	18	− 7
,, *U.S.A.*	301	− 69
Elec. heating apparatus	1,147	− 110
From U.K.	28	− 28
,, *W. Germany*	11	+ 5
,, *U.S.A.*	1,100	− 90
Dynamos, generators and parts	9,351	− 631
From U.K.	917	− 314
,, *W. Germany*	293	+ 272
,, *Sweden*	114	+ 103
,, *Switzerland*	103	+ 89
,, *U.S.A.*	7,856	− 847
Fuses, fuse plugs, cutouts and parts	956	+ 158
From U.K.	94	+ 31
,, *U.S.A.*	860	+ 125
Fluorescent tubes and arc lamps	676*	+ 270
Lamps, elec., m.f.	1,778	− 1,251
From U.K.	53	+ 41
,, *Japan*	88	+ 54
,, *Netherlands*	45	+ 35
,, *U.S.A.*	1,582	− 1,576
Head, side and tail lights and torches	1,106	+ 28
From U.K.	36	− 9
,, *Hongkong*	190	+ 50
,, *U.S.A.*	826	− 36
Elec. light fixtures	5,550	+ 80
From U.K.	67	− 19
,, *W. Germany*	58	+ 7
,, *Italy*	50	− 11
,, *Japan*	54	+ 4
,, *U.S.A.*	5,220	+ 100
Lightning arrestors and reactors	309	+ 67
From U.K.	82	+ 55
,, *U.S.A.*	174	+ 30
Elec. meters and parts	2,043	+ 488
From U.K.	304	+ 124
,, *U.S.A.*	1,685	+ 350
Elec. motors, under 10 dols.	255	− 104
From U.K.	15	− 16
,, *U.S.A.*	222	− 87
Other elec. motors and parts	11,970	− 3,569
From U.K.	1,947	− 346
,, *W. Germany*	111	− 5
,, *U.S.A.*	9,702	− 2,981
Rheostats, controllers and starters	8,403	− 617
From U.K.	466	+ 78
,, *Switzerland*	67	+ 18
,, *U.S.A.*	7,841	− 751
Elec. irons and parts	658	+ 252
From U.K.	55	− 15
,, *U.S.A.*	599	+ 263
Self-contained lighting outfits	53*	− 9

Class of Goods	1954 $ (000)	Inc. or dec. on 1953 $ (000)
Switches, switchboards and parts	10,767	+ 116
From U.K.	1,155	+ 17
,, *Switzerland*	706	+ 200
,, *U.S.A.*	8,777	− 213
Switchgear for mines	96	− 49
From U.K.	49	− 30
,, *U.S.A.*	47	− 18
Telegraph apparatus and parts	3,270	− 838
From U.K.	681	+ 124
,, *U.S.A.*	2,585	− 964
Telephone apparatus and parts	10,514	+ 1,543
From U.K.	1,848	− 714
,, *Sweden*	44	+ 19
,, *Switzerland*	62	+ 47
,, *U.S.A.*	8,536	+ 2,194
Transformers and parts	5,709	+ 695
From U.K.	1,428	− 271
,, *Switzerland*	168	+ 89
,, *U.S.A.*	3,924	+ 705
Radio valves	8,803	− 5,915
From U.K.	206	− 244
,, *Netherlands*	120	+ 82
,, *U.S.A.*	8,476	− 3,754
Radio apparatus, n.o.p.	58,454	+ 16,759
From U.K.	4,700	+ 1,917
,, *Netherlands*	377	+ 94
,, *U.S.A.*	53,258	+ 14,654
Elec. dry-shaving machines	3,186	+ 801
From Netherlands	366	+ 153
,, *U.S.A.*	2,749	+ 593
Elec. steam generators and parts	3,013	− 4,341
From U.K.	1,895	− 4,698
,, *Switzerland*	505	+ 65
,, *U.S.A.*	595	+ 274
Elec. precision instruments	5,814	+ 1,366
From U.K.	324	− 820
,, *France*	60	− 33
,, *U.S.A.*	5,307	+ 1,220
Radio receiving sets	921	− 331
From U.K.	43	+ 6
,, *W. Germany*	24	+ 16
,, *U.S.A.*	852	− 352
Television receiving sets	2,080*	− 174
Vacuum cleaners	3,138	− 319
From U.K.	1,079	− 48
,, *Netherlands*	247	+ 115
,, *U.S.A.*	1,780	− 366
Elec. washing machines	3,025	+ 420
From U.K.	77	− 60
,, *U.S.A.*	2,947	+ 79
Elec. cooking stoves, over 25 dols.	2,016*	+ 178
Elec. cooking apparatus, n.o.p.	2,832	− 118
From U.K.	208	− 31
,, *U.S.A.*	2,609	− 91
Elec. refrigerators, n.o.p.	17,760	− 2,689
From U.K.	146	+ 33
,, *U.S.A.*	17,612	− 12,648
Sockets, outlets, receptacles, etc.	1,808*	+ 86

* Mainly from U.S.A.